PAGES

MISSING

The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

FILTRATION PLANT AT AYLMER, P.Q.

Crushed Marble Mixed With Silica Sand as Filtering Medium in Gravity Type Mechanical Plant —Paper Read Last Month Before Ottawa Branch of The Canadian Society of Civil Engineers

By H. LLEWELLYN SEYMOUR, B.A.Sc., A.M.Can.Soc.C.E.
Topographical Surveys Branch, Dept. of Interior, Ottawa

Verse 19—And the men of the city said unto Elisha, Behold, I pray thee, the situation of this city is pleasant, as my lord seeth: but the water is naught, and the ground barren.

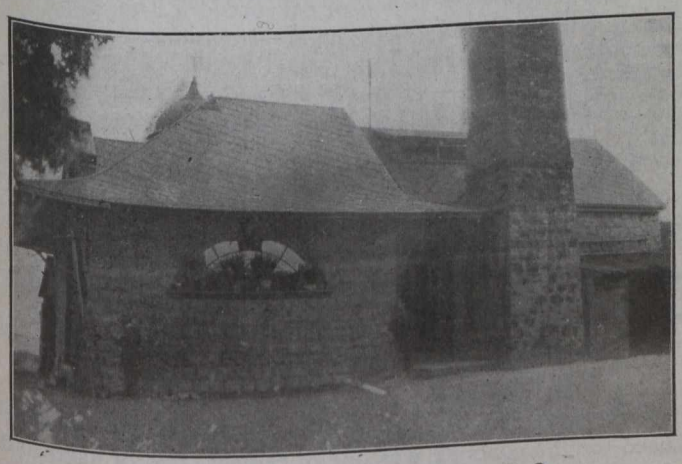
20—And he said, Bring me a new cruse, and put salt therein. And they brought it to him.

21—And he went forth unto the spring of the waters, and cast the salt in there, and said, Thus saith the LORD, *I have healed these waters; there shall not be from thence any more death or barren land.*

22—So the waters were healed unto this day, according to the saying of Elisha which he spake.—(II Kings—chap. 2)

IN this brief description, the whole philosophy of the science and art of water purification is vividly portrayed or suggested. As to the means of purification employed, it has been suggested that there may be here a reference to the ability of certain salts to coagulate water and thus effect clarification. In any event it is known that this valuable coagulation property of aluminium and other salts has for centuries been made use of by the Chinese. It has also been stated that in very early times the purification of the Nile water in Egypt was accomplished by adding alum to the water, with subsequent filtration through small household filters.

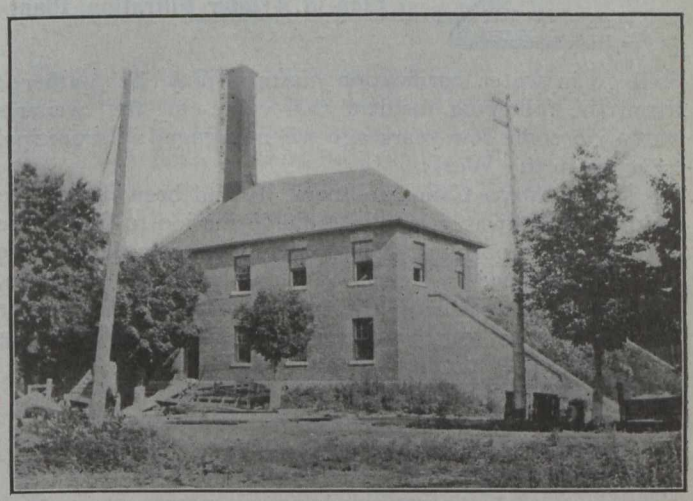
In modern times this method of water purification, filtration preceded by coagulation, was probably not



Old Pumping Station, Aylmer, P.Q.

practised until after Isiah S. Hyatt obtained in 1884 a patent in the United States for such a process. It was soon found that the use of a coagulant in conjunction with the mechanical or rapid sand filter, which latter was designed originally only as a roughing filter in the manufacture of paper, provided an efficient and rapid means of purifying municipal water supplies. This method, variously termed rapid sand, mechanical or American filtration, originated in the United States and has there been perfected in its various mechanical details.

As exemplified in the Aylmer filtration plant, modern mechanical filters, and more particularly those of the gravity type, now compare most favorably with the slow sand, English or European filters for the purification and

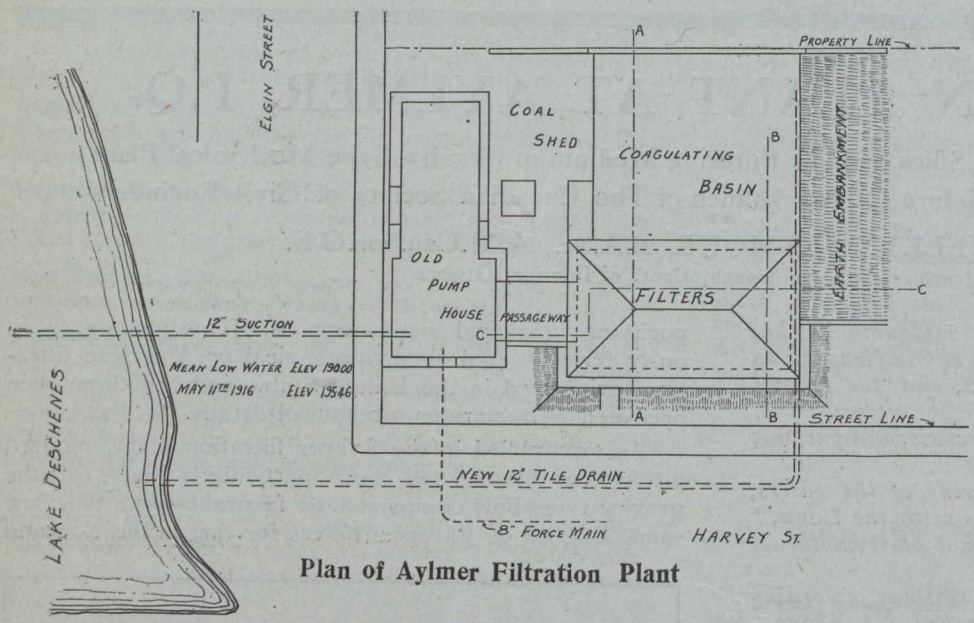


New Filter Building, Aylmer, P.Q.

especially for the clarification of most waters encountered on this continent. The slow sand method was successfully practised across the Atlantic over half a century before the superiority of the rapid sand process (requiring about one-fiftieth of the area and at about one-half the constructional cost) in filtering waters high in turbidity and color was recognized. Slow sand filtration has had many strong adherents, but it is significant that several large cities are adopting the feature of coagulation in their slow sand filter plants. When the city of Toronto wished recently to increase the capacity of its purification works, there was added to the existing slow sand filters, mechanical filters of the "Ransome Drifting Sand" type. In a paper recently read before the New England Water Works Association, Geo. A. Johnson, consulting engineer, of New York City, stated that in Canada twice as many people were supplied with water from rapid sand as from slow sand filters.

The popularity of the rapid sand filter has grown as the prejudice against the chemical treatment of water has been dispelled by favorable reports after careful scientific investigation and by the absence of ill effects upon communities using water purified by such treatment. For

the layman, the chemical action of alum salts in effecting coagulation in turbid waters has been popularly compared to the action of the white of an egg on coffee; the grounds are settled and the consumer gets clear coffee, no grounds and no egg. How far imagination based on prejudice will go in water purification matters, may be gathered from the following incident that came to the writer's attention some few years ago when engaged in municipal practice in the West:



Plan of Aylmer Filtration Plant

In a western Canadian town it had been decided to chlorinate the water supply, the chlorination to commence on a Monday morning. By Monday noon complaints were being telephoned in, objection being taken to the taste, smell and appearance of the treated water. As a matter of fact, due to some unexpected delay, the chlorinating plant did not operate till the next day. Could such an occurrence be classified under "Psychological Aspects of Water Purification"?

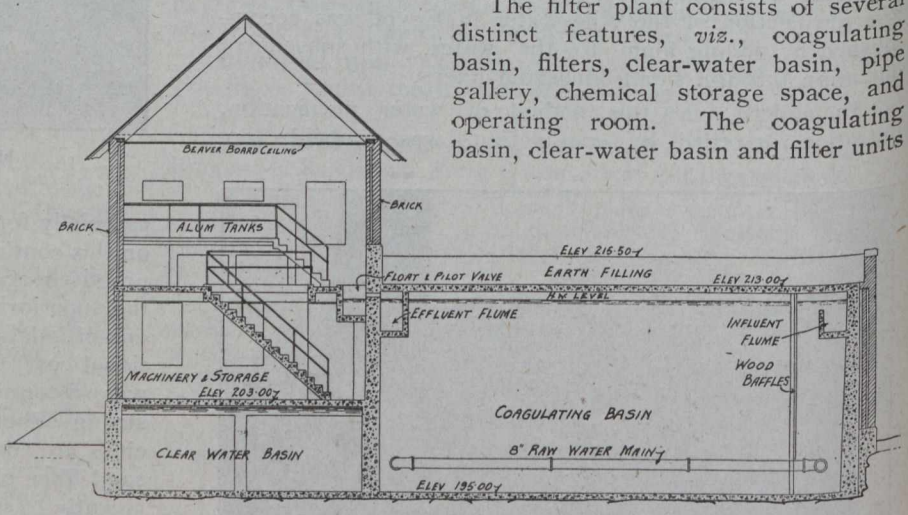
Judged philosophically, the Aylmer filtration plant might be regarded as a mere aggregation of mechanical devices; but many of these devices are patented, and all are the result of much experiment and experience. The object of this paper is to describe briefly some of the features of the Aylmer plant of general interest to engineers.

Aylmer, where the source of public water supply is the Ottawa River, was required to install a water purification plant by order of the Quebec Superior Board of Health under section No. 3911A of the Quebec Public Health Act, as amended in 1915. This section requires a municipality to install purification works, if after due investigation the board so orders. Plans and specifications for the proposed works were prepared by Jas. O. Meadows, sanitary engineer, of Montreal, and the contract was awarded in September, 1916, to R. T. Smith & Co., of Montreal, with the New York Continental Jewell Filtration Co. as sub-contractors for the filter equipment and pumping machinery. The plans and specifications and the awarding of the contract were similar to others which have been previously awarded in Quebec Province and throughout the Dominion, with the exception of one clause in the guarantee required from the contractor. This clause required that the contractor specify the period of time for a continuous run of the filter without the passage of aluminum hydrate or suspended matter. The presence or absence of hydrate is to be determined by an examination of the filtered effluent, and the hydrate is not to be visible to the naked eye after the sample has stood for twenty-four hours.

Ottawa River water at Aylmer receives pollution due to the discharge of municipal and private sewers located at various points above the municipal intake, and also from the Aylmer sewer outlet itself, though it is located below the water intake. This latter pollution is due to the fact that the sewage is sometimes carried up-stream by winds which create a flow in that direction stronger than the natural velocity of the current. Ottawa River water is soft and though highly colored is, generally speaking, low in turbidity. The water in many respects is nearly ideal for all domestic and manufacturing purposes, and if it were not for the fact that pollution enters the river at various points, it would be a safe water for drinking purposes. Because of the comparatively high color content of the Ottawa River water, mechanical or rapid sand filtration is the most efficient method of purification for this supply, and was one of the reasons for the adoption of this type of filtration for the town of Aylmer.

The purification plant is located east of the pumping station and is connected to the pumping station by means of a spacious passageway, in which is located the low-lift pumping units.

The filter plant consists of several distinct features, *viz.*, coagulating basin, filters, clear-water basin, pipe gallery, chemical storage space, and operating room. The coagulating basin, clear-water basin and filter units are all constructed of reinforced concrete. The mixture used for the concrete was one of cement, two of sand and four of broken stone. The mixing and placing of the concrete was carefully done, great care being required to make the several basins water-tight. This was accomplished without the use of any waterproofing material. The building over the filters is of brick, the 15-in. wall being laid up with a 2-in. air space. The roof is supported on wooden trusses, the outside covered with asbestos shingles and the inside sealed with "Beaver Board."



Section on Line A-A of Plan

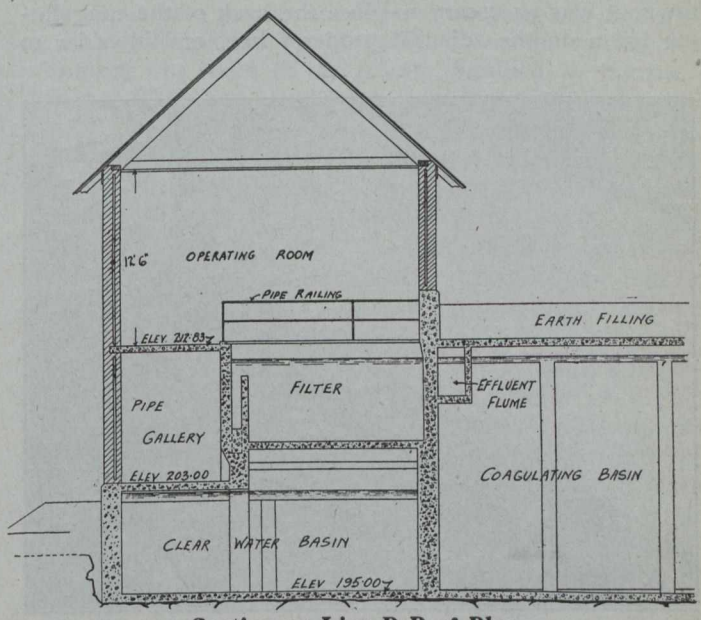
The low-lift pumps consist of one direct connected, motor-driven, centrifugal pump and one direct connected, steam-turbine-driven pump, each having a capacity of 700 U.S. gallons per minute. These pumps are designed to lift against a head of 30 ft. The motor-driven pump will serve as the regular pumping unit, the steam turbine pump to be used as stand-by in case of electric power failure at any time. The existing intake from the river, widened at this point to Lake Deschenes, is utilized by the low-lift pumping units, the suctions being so connected to this intake that the raw water may be pumped directly to the coagulating basin. Or at any time, should the need arise, the same intake may be used by the high-lift pumping units.

The Chemical Feed

It is desirable to maintain a constant level in the coagulating basin. This is accomplished by placing on the discharge line of the low-lift pumps a hydraulic valve operated by a pilot valve and float placed in a chamber at the high-water line of the coagulating basin. It is possible, by the adjustment of the float, to vary the elevation of the water in the coagulating basin about 6 inches. The function of the hydraulic valve is to throttle, when necessary, the discharge from the pump, which operates at constant speed; or in case of the water lowering, to open and allow more water to pass, thus maintaining the constant level desired in the basin.

The plant is designed to use sulphate of alumina as a coagulant. The tanks for the preparation and storage of this solution are located on the filter operating floor level, the solution being fed by gravity to the raw water. The solution tanks are two in number and have a capacity of 500 U.S. gallons each. Each solution tank is provided with a dissolving tray, water-motor-driven agitating devices and alum solution filters. The tanks are of concrete, the inside surface having been specially treated with creosote oil and Barrett Specification pitch to prevent the action of the sulphate of alumina. All of the piping and fittings in connection with the solution tanks are either of acid bronze or lead. Proper drain outlets are provided and there are also provided depth gauges carefully calibrated to record the quantity of solution passing from the tanks.

Three orifice boxes are provided for measuring the sulphate of alumina solution which passes to the water to be treated. These boxes are located just north of the solution tanks, on the operating floor level. The alum solution passing from one orifice box is used for the primary treatment of the raw water, and the discharge from this box flows by gravity to the discharge line from the low-lift pumps, thereby adding to the raw water, as it enters the coagulating basin, a definite amount of coagulant. The second and third orifice boxes are used for the secondary application of coagulant to the already treated water, at points directly opposite the outlet of each basin. These boxes are provided with float valves,

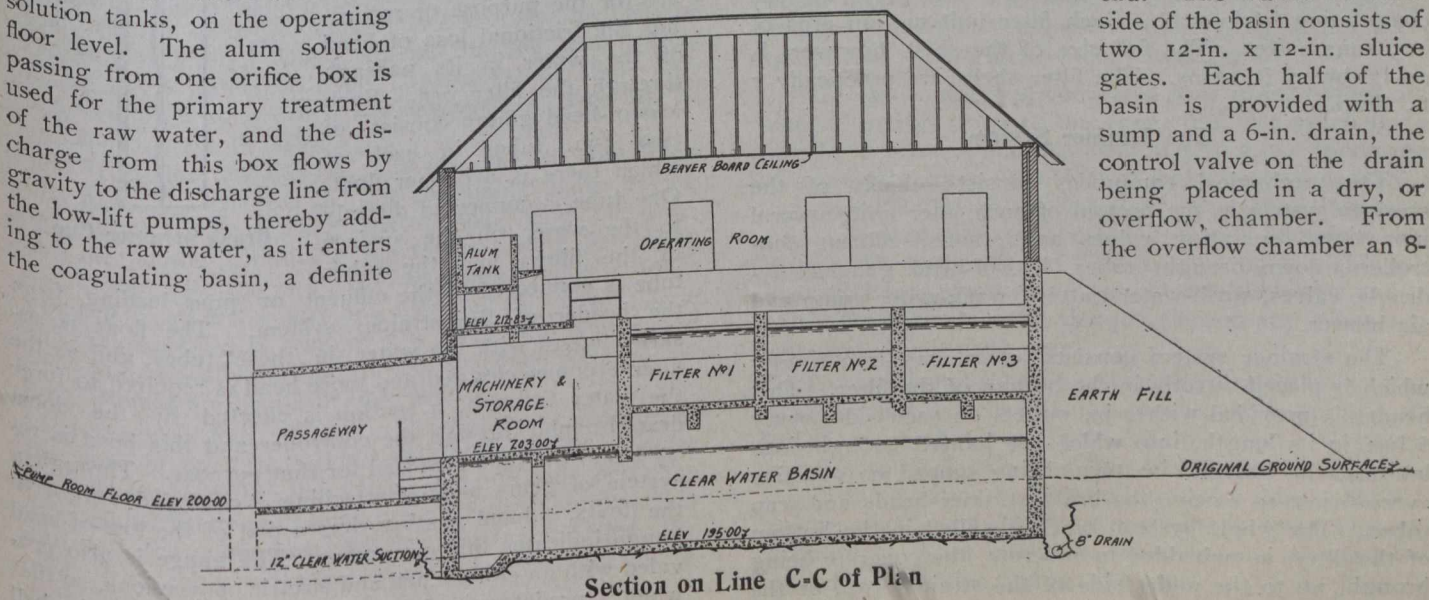


Section on Line B-B of Plan

calibrated hard rubber orifices and gates. By manipulation of the gates, a known quantity of solution can be fed, the solution passing to receiving boxes below the orifice, from which point it flows by gravity. The lining of the solution tanks and the filtering of the solution are refinements not found in many previous installations.

The Coagulating Basin

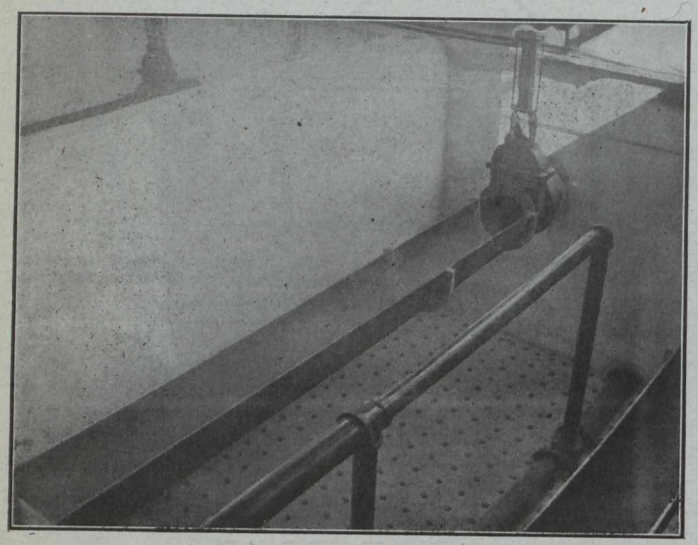
The coagulating basin is divided into two parts, each part being practically 40 ft. long by 18 ft. wide, 16½ ft. deep. The time period in the coagulating basin is four hours, when the plant is operating at its designed capacity of 1,000,000 U.S. gallons per day, and the velocity through the basin under that condition is about ⅛ ft. per minute. The basin is provided with an inlet chamber and inlet flume, the water flowing into the basin at the high-water level. By a baffle at the inlet end, the water is immediately directed to the bottom of the basin, and from this point moves longitudinally and upward to the outlet end. The outlet of each side of the basin consists of two 12-in. x 12-in. sluice gates. Each half of the basin is provided with a sump and a 6-in. drain, the control valve on the drain being placed in a dry, or overflow, chamber. From the overflow chamber an 8-



Section on Line C-C of Plan

in. drain leads to the river. The coagulating basin is covered on top with 2½ ft. of earth and is banked at one side by an earth fill.

In locating the plant on the property owned by the town, it was necessary to place the back of the coagulating basin on the adjacent property line, and in order to



Bottom of a Filter Before Putting in the Media

prevent the water in the basin freezing, a frost-proof wall was constructed. The back wall of the basin is of concrete, approximately 12 ins. thick. The frost-proof wall consists of the concrete wall backed up by two brick walls, one 4 ins. thick and the other 8 ins. thick, leaving an air space next to the concrete wall and an air space between the two brick walls. This frost casing will prevent the freezing of the water in the basin. Manholes are provided in the top of the basin for entrance into the inlet chamber, overflow chamber, each half of the basin and outlet flume.

The clear-water basin is located immediately below the filters and the pipe gallery. The capacity of this basin is approximately 50,000 U.S. gallons. On the side adjacent to the old pumping station there is provided a sump from which the clear-water suction is taken to the high-lift pumps.

Directly over the clear-water basin are located the filters. These are three in number and back up the coagulating basin wall. Each filter unit has an area of 125 square feet. The full size of the shell, however, is 10 ft. by 13 ft. 9 ins. The filter shells are practically 7 ft. deep.

The Strainer System

The mechanical equipment consists chiefly of the strainer system in the bottom of each filter unit, several pipe lines, operating valves and stands, effluent controllers, down draught tubes, loss-of-head gauges, hydraulic valves, wash-water gutters, wash-water pump and air blower.

The strainer system consists of a cast-iron header which is placed directly in the bottom of the filter. This header is provided with 2-in. outlets on each side, every 6 ins. in its length, into which are jointed wrought-iron laterals, the laterals in turn being tapped on one line every 6 ins. to receive the brass strainer heads and trap tubes. The whole system, when installed in the bottom of the filter, is embedded in concrete, the concrete being brought up to the under side of the strainer cap, or the point of lowest waterway in the cap. All strainer heads are placed at one level. Through them, filtered water passes out and through them, when the filter is being cleaned, air and wash water enter.

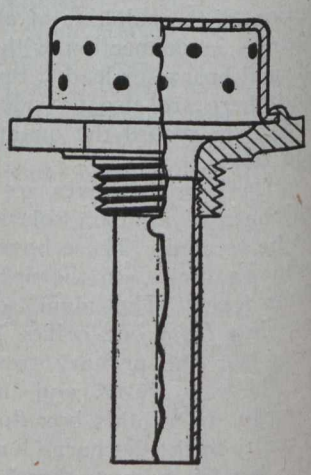
On top of the strainer system there is placed 9 ins. of graded gravel, this gravel being specially prepared and sized, the larger size being from 1 in. to ¾ in. and the smaller size ⅛ in. On top of the gravel is placed 27 ins. of filtering material. This material consists of two-thirds silica sand and one-third crushed marble, the marble being screened to the same size as the sand.

Other Mechanical Equipment

Immediately over the sand, and 13 inches above it, are located two wash-water gutters in each filter. These gutters are of cast iron, the lips being planed to a true line so that all may be placed level. These gutters are practically 12 ins. wide and are 6 ins. deep at one end and 10 ins. deep at the outlet end. At the outlet end they are provided with a casting for placing in the breast wall of the sewer sump.

The several pipe lines, or immediate filter piping, consist of the wash-water drain (or sewer), the effluent pipe, the wash-water main and the air main. The air main is connected to the air blower and passes through the pipe gallery, through the front wall of the filters, downward through the filter bed and connects to the header section of the strainer system. The wash-water main passes through the pipe gallery and is connected to the header section outside of the filter shell. The effluent piping is also connected to the header section of the strainer system outside of the wall. The drains are connected to the sewer sump at the face of the filters. All of these different lines are provided with gates, the stems of these gates reaching to the operating floor, where they are provided with floor stands and hand-wheels, each hand-wheel being plainly marked, denoting which valve it operates.

The effluent controllers used in this plant are of the Venturi type and they serve the purpose of controlling the flow of the effluent from the filters; that is to say, they maintain a constant rate of flow at all times.



Brass Strainer Cap

The loss-of-head gauges, one provided for each filter, are for the purpose of recording the frictional loss of head of the water in its passage through the filter bed. Each loss-of-head gauge consists of two 5-in. tubes in each of which there is a copper float. One tube is connected directly to the water on the surface of the filters and the other tube is connected to the effluent or pipe leading from the header of the strainer system. The float necessarily moves with the water in these tubes, and as the filter becomes clogged and more head is required to force the water through, a suction is effected by the down draught tube through the controller and this head is recorded in the tube provided for that purpose. Through a system of gears and by attaching a cord and weight to the floats, a hand passing over a dial of the loss-of-head gauge indicates this movement. The gauge is also provided with an electric bell and electric connections, so that when a predetermined loss of head is obtained, the bell

will ring and advise the filter operator. At this time the filter must be washed.

Washing the filter is done by closing the gate valve which admits the water from the coagulating basin, filtering or draining off the water left in the shell to a point 5 ins. below the lip of the gutter, closing the effluent valve and opening the sewer valve. The bed is then agitated with air by starting the air blower and opening the air valve. After the sand is sufficiently agitated to free it of the dirt accumulated on the particles, the air is shut off and the wash-water pump started and the wash-water valve opened, the wash water passing through the wash-water main, the header section and laterals of the strainer system, upward through the gravel and sand, the dirty water passing off by the wash-water gutters and sewer. The operation of washing a filter requires ordinarily from five to six minutes.

A new and interesting feature in connection with the Aylmer plant is the composition of the filtering medium. The beds, as before stated, consist of two-thirds silica sand and one-third crushed marble, both with an effective size of .45 mm. and a uniformity coefficient of 1.65. The function of the crushed marble is to prevent by chemical action the presence of free alum in the filtered water and to correct any excess of carbon dioxide. While crushed marble has been used for several years in pressure filter installations, it is a comparatively new development to use it in a gravity plant, and it is my understanding that this is the first time that it has been done, at least in Canada.

The normal rate used for filtering, and the one for which the plant was designed, is 2 U.S. gallons per square foot per minute of filter area, or 125,000,000 gallons per acre per day, or from forty to fifty times the rate of slow sand filtration. The wash-water pump, wash-water mains and strainer system and gutters are designed to care for wash water at the maximum rate of 9 U.S. gallons per square foot of filter area per minute. The air blower, air mains, etc., are designed to provide for the

(Concluded on page 388.)

LAKE OF THE WOODS REPORT

The Federal Printing Office at Washington has now issued for the International Joint Commission, the final four volumes of the commission's report on the Lake of the Woods levels. These volumes include text, tables, plates and a watershed map. Accompanying these four volumes is an atlas which was reviewed on page 281 of our September 27th issue.

The volumes are 6¾ ins. x 10 ins., the one containing text having 314 pages; the one containing plates having 144 plates of various size, most of them being folded in; and the volume containing the tables having 82 tables, occupying 330 pages. The water-shed map is lithographed in several colors and mounted on canvas; it is approximately 3½ ft. wide by 3 ft. deep, and is arranged so as to fold neatly into the stiff covers of the volume. All four volumes are bound in blue cloth.

Besides the four volumes and atlas above mentioned, the work of the International Joint Commission and its engineers in regard to these Lake of the Woods levels has required publication of eleven other volumes, six of which deal with the public hearings in the investigation, the other five being advance reports by the consulting engineers.

CEMENT JOINTS FOR CAST-IRON WATER MAINS

IN *The Canadian Engineer* of May 24th, 1917, there appeared a paper read before the American Society of Civil Engineers by Clark H. Shaw in which were brought out some of the results obtained by the use of cement joints for cast-iron water mains.

The following discussion of this subject is taken from the August, 1917, Proceedings of the American Society of Civil Engineers:—

H. B. Lynch: This method of caulking joints in cast-iron pipe deserves a wider use, not only on account of its low cost, but because it makes a better joint, at least where no considerable movement of the pipe is expected after it is laid.

Cement joints have been adopted as standard at Glendale, Cal., and have been used on 10 miles of cast-iron pipe laid in the past two years. This joint was not adopted until after investigation had shown that it is being used with perfect satisfaction in various Southern California localities, and tests had been made to show its effectiveness. The results obtained at Glendale have been similar to those described in the paper. No joint yet placed has shown permanent leakage, and, in only four, has the presence of dampness been detected after the pressure was turned on. No joint has required recaulking.

The strength of this joint has been shown at Glendale by several incidents of various kinds. As a matter of fact, it is customary for the pipe crew to take the greatest liberty with the pipe after the joints are completed, as experience has shown that a joint properly made will not be started by quite severe treatment. A 3-mile pumping main of 20-in. cast-iron pipe recently completed was entirely laid up with cement, at an estimated saving of more than $3,000. On this line, when a nipple was to be caulked into a cross, it was customary for the men to stand the cross on end on the surface of the ground and set the nipple into the top bell, and caulk up on the surface. The nipple and cross, weighing 3,000 lbs., were then picked up with the chain blocks and lowered into the trench, without waiting for the set to occur. No joint treated in this way showed the slightest leakage or dampness under a pressure of 90 lbs. On one occasion, a 20-in. cross had caulked into it a plug, a reducer, and a 20-in. nipple, 10 ft. long. This whole assembly, weighing about 4,000 lbs., was lowered into place as soon as caulked, and is at present operating under a pressure of 90 lbs. per square inch without seepage.

This 20-in. line was connected to a 16-in. riveted steel line. For this purpose the 16-in. line was taken out of service at 8 p.m., and put back at 4.30 a.m. Joints were given 4½ hours to set. Out of eight joints thus treated, one remained damp for one day. One joint, where the 16-in. riveted line was caulked into a cast-iron bell, dripped for two days and then took up tight. This joint showed a face of about 1¼ ins. between the pipe and the bell. No other joint on this job showed any initial seepage, and all are tight now.

The method of making a joint in Glendale is much the same as that described in the paper. After yarning, the joint is rammed full of slightly damp cement. Great care is taken to caulk this first ring of cement thoroughly, as this is the greatest factor in a successful joint. No bead is now used, as no difference in results is noted when this is omitted. After caulking, the joints are covered with earth for protection against the sun.

The tools used are slightly wider than those used for caulking with lead.

In spite of the strength of the joint, its removal is surprisingly easy. At different times, 20-in. plugs have been taken out, and there has not been the slightest difficulty where the method described in the paper was used. To caulk a joint of this size the writer allows about one hour's time of one man.

Edward R. Bowen: The writer has read this paper with keen interest. It gives in admirable detail the results of an extended experience in handling the cement joint in cast-iron pipe construction. The advantages of this type of joint have not been generally realized among water-works engineers. It is not only less expensive than the lead joint, but, in some ways, distinctly better.

As protection against electrolysis it is almost a perfect insulator. Tests made at the Long Beach Water Department yards showed the resistance of cement joints on an 8-in. line to be nearly 19 ohms, or more than three times the resistance of the ordinary lead joint. Because of the high resistance, under ordinary electrolytic conditions, extremely small currents could travel along the pipe line. Tests were made in Long Beach in the vicinity of an electric railway sub-station to determine the quantity of current carried by the water-pipe lines. In this particular location there were cast-iron lines with both lead and cement joints. The position of the pipe lines with respect to their susceptibility to electrolytic action was practically the same. An appreciable flow of current was discovered in the pipe lines with the lead joints, and a very much smaller flow was noted in the line with the cement joints. In the latter instance, however, the same drop in potential could be obtained by inserting the connections in the soil at the same distance apart as they were applied to the pipe lines.

In the writer's opinion, the success or failure of the cement joint depends solely on the method used in its construction. It is extremely important to have as little moisture in the cement as possible. The mixture described in the paper has proved to be entirely satisfactory, and care should be taken to avoid using more moisture than is there recommended. If more water is used the cement in setting shrinks away from the pipe, resulting in a leaky connection.

Table 6.—Cost of Cement Joints

Diameter of pipe, in inches.	Jute.		Cement.		Labor.		Total cost of joint.
	Pounds per joint.	Cost at 6 cents per pound.	No. of joints per sack.	Cost at $1.00 per sack.	No. of joints per 8-hour day.	Cost at $2.75 per day.	
4	0.14	$0,008	24	$0 042	50	$0.055	$0.105
6	0.19	0.011	18	0.056	42	0.065	0 132
8	0.24	0.014	14	0.071	34	0.081	0 167
10	0.43	0 026	11	0.091	28	0 098	0.215
12	0.51	0.031	8	0.125	24	0.115	0.270
14	0.58	0.035	7	0.143	20	0.138	0.315
16	0.66	0.040	6	0.167	17	0 162	0.368
18	0.73	0.044	5	0.200	14	0.196	0.440
20	0.80	0.048	4	0 250	11	0.250	0.548
24	0 95	0.057	3	0 333	7	0.393	0 783

Tables 6 and 7 have been prepared to illustrate the relative costs of the two types of joints. Table 6 is based on the data in the paper. Table 7 is based on the cost data assembled by the Los Angeles City Water Department.

George W. Pracy: Several months ago the Spring Valley Water Company laid 4,730 ft. of 4-in., 900 ft. of 6-in., and 827 ft. of 8-in. cast-iron bell-and-spigot pipe, with cement joints.

Table 7.—Cost of Lead Joints

Diameter of pipe in inches.	Lead.		Yarn.		Fuel at 0 6 per pound of lead.	Labor cost, based on $2.75 per man per day.	Total cost of joint.
	Pounds per joint.	Cost at 6 cents per pound.	Pounds per joint.	Cost at 6 cents per pound.			
4	7	$0.420	0.2	$0.012	$0.042	$0.110	$0.584
6	9	0.540	0.4	0.024	0.054	0 168	0.786
8	14	0.840	0.5	0.030	0.084	0.216	1.170
10	16	0.960	0.6	0,036	0 096	0.230	1.322
12	20	1.200	0.8	0.048	0.120	0.264	1.632
14	24	1.440	0.85	0.051	0.144	0.310	1.945
16	29	1.740	1.0	0.060	0.174	0.324	2.298
18	31	1.860	1.1	0.066	0.186	0.360	2.472
20	35	2.100	1 3	0.078	0.210	0.432	2.820
24	40	2.400	1.5	0.090	0.240	0.492	3.222

The cement was mixed by one man who handed it around to the two or three men making the joints. No caulking was done on the joints, the cement being tamped by hand with a caulking iron. After the joint was full, a bead was put on around the face of the bell. Neat cement was used. Just as little water as possible was added in mixing. When ready for use, the wet cement was still dry enough to crumble when handled. The first few joints were filled with a wet mix, with the result that, in these joints, the cement shrunk away from the iron, and all the joints had to be remade. As an experiment, one of the 8-in. joints was caulked hard, using an extra dry cement. This gave a good joint, but not better than the others. and it took twice as long to make.

Water was turned into the pipes 48 hours after the last joint was made. For the first day nearly every joint leaked. After that, they took up rapidly and, at the end of one week, all were tight.

The pipe was laid in five sections of about 1,300 ft. each. All but one section was tested by measuring the quantity pumped into the section during a given period. Tests were made after the pipe had been under ordinary working pressure for about 1 week to 10 days. For the first section laid, this leakage was ⅓ gallon per lineal foot of pipe joint per 24 hours. The second leaked so slowly that the leakage could not be measured. The last two sections laid were absolutely tight. The lines were pumped to pressure and left standing, in one case, for ½ hour and in the other case for 2½ hours, without any drop in pressure. The 6-in. pipe section could not be tested, as it was necessary to put it into use immediately.

The quantity of cement used was as follows:—

No. of joints.	Size.	Quantity of cement, in pounds.
187	4-in.	
2	5-in.	750
12	8-in.	
78	6-in.	360
168	4-in.	
86	8-in.	1,715

These figures include all waste. On an average the 4-in. joints took about 4 lbs., the 6-in. joints 5 lbs., and 8-in. joints from 7 to 9 lbs. These figures are rough approximations, based on the theoretical quantity necessary for a joint of each size.

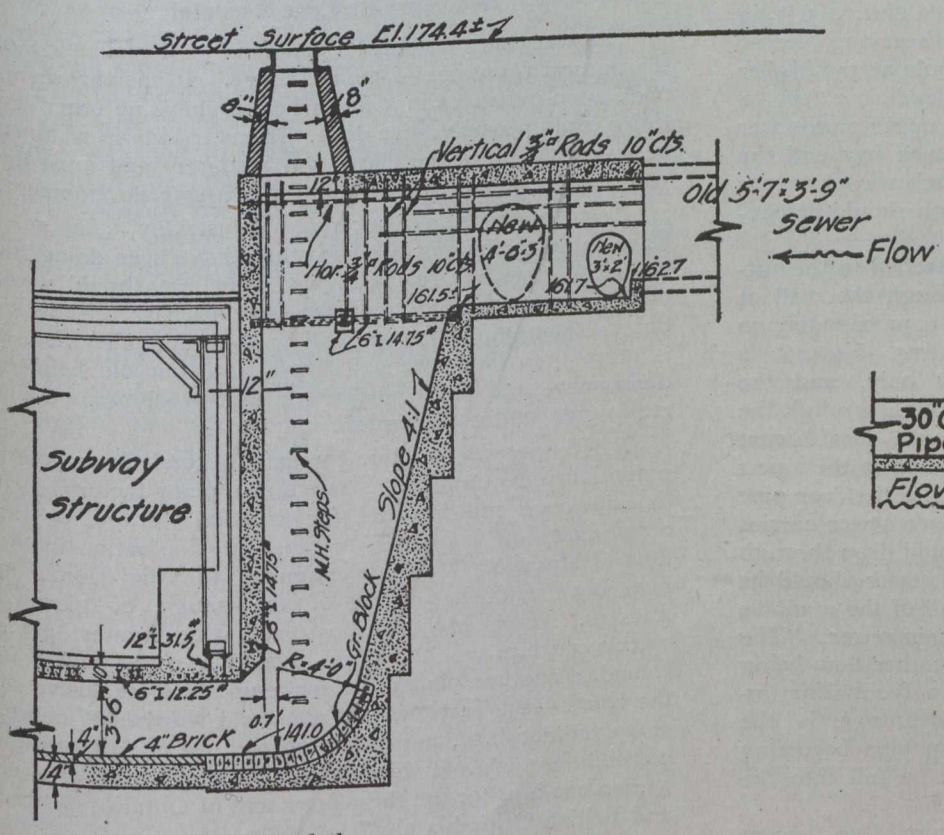
The fire hydrants on the line were set with lead joints, as it was feared that the vibration of the hydrants, when in use, would break the cement joints.

The lines have given entire satisfaction.

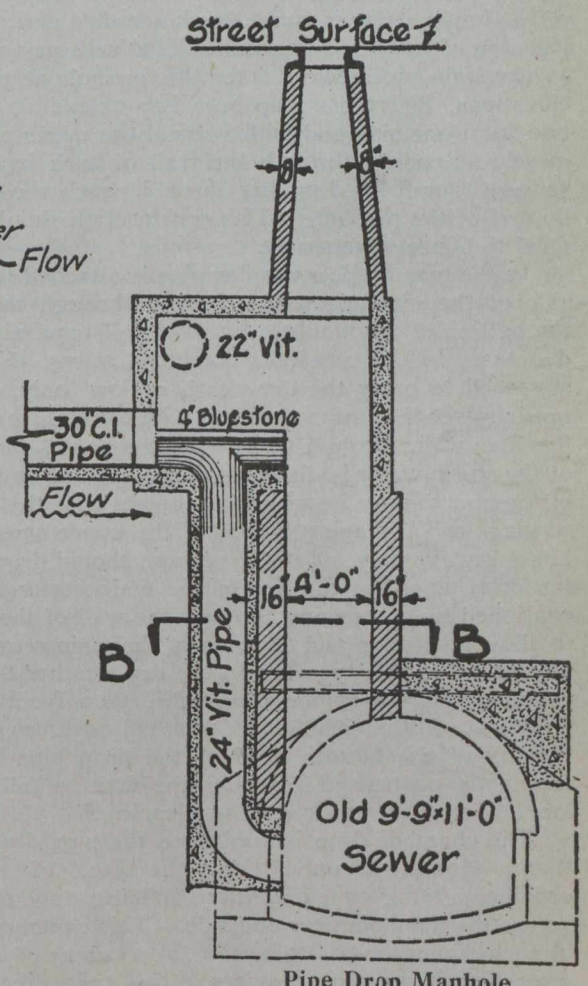
DROP MANHOLES FOR SEWERS*

By Irwin W. Whittemore

DROP MANHOLES are generally used to meet one of two conditions: The surface of a street may be so steep that to build a sewer parallel to it would cause a velocity of sewage which would result in erosion and abrasion of the sewer invert, which may be avoided by using flatter grades connected by drop manholes. The other condition is the interference of other underground structures with the continuous grade of the sewer, requiring it to be carried under such structures either by an inverted siphon, or by a drop manhole at the up-grade of such structure and a sewer with flattened grade carried from the bottom of such manhole underneath the structure. A third condition occasionally exists, where a main or intercepting sewer is carried at considerable depth, sometimes in a tunnel, in which case the tributary sewers, which are at a much higher elevation, are connected with it by drop manholes.



Recess Drop Manhole



Pipe Drop Manhole

In addition to the cost of such manholes an objection to their use exists where the sewage is to be treated by screening, since the churning up of the sewage which occurs in drop manholes results in a mechanical disintegration of the solids and thus considerably reduces the percentage of suspended solids that can be removed by screening.

Where a drop manhole is to be used, it should as far as possible possess the following characteristics: Accessibility for examination and cleaning; protection of the interior of the manhole from excessive erosion; and the reduction to a minimum of any deleterious effects on the sewage which may make it unsuitable for the method of disposal which is in use.

The first object of the design should be to obtain a manhole which will afford convenient access to all sewers radiating therefrom. This requires that a man be able to enter the manhole and examine and clean the sewer during dry weather without coming in contact with the flowing sewage. To accomplish this purpose, vertical pipes are sometimes provided in which the dry-weather flow is confined while it is passing from the upper to the lower sewer. In other cases a vertical recess is provided of a sufficient depth so that the falling stream does not encroach upon the manhole shaft proper. In special cases it is sometimes desirable to have the manhole accessible during times of storm as well as during dry weather. In some cases separate vertical chambers confine both the sewage and the combined storm flow so that the manhole proper can be entered safely.

Erosion of the bottom and inside faces of the manhole may be prevented by providing a free path for the storm flow so that no erosion can occur except at the bottom and lining the bottom with a wearing surface of vitrified brick, granite block, or other hard durable material. Water cushions also are sometimes used at the bottom where the drop is considerable.

Various means for breaking the fall have been devised and used for the purpose of minimizing erosion from both dry-weather and storm flows. These cause considerable churning, however, and it is well to design drop manholes, when they are unavoidable, so as to minimize churning.

*Abstract of paper read before the Municipal Engineers of the City of New York.

The several types of drop manholes are classified as follows: The open drop; the recess drop; the pipe drop; the chamber drop; and the cascade and ramp drop.

The open drop is merely an ordinary manhole sometimes slightly enlarged in diameter, into which the sewer discharges. This type should be used only where small sewers of moderate flow are concerned.

In the recess drop manhole the side of the manhole towards the upper sewer is sloped from the bottom of the manhole to the invert of such sewer, so that at such invert the diameter parallel to the axis of the upper sewer is considerably greater than at the bottom of the manhole or than the upper portion of the manhole above said sewer. In New York the slope of one to four is common. This produces a recess in the manhole below the upper sewer, down which recess the sewage from such sewer glides. The junction between the slope and the bottom of the lower sewer is curved with a radius of 3 to 5 ft. in the case of large sewers, and is lined with paving blocks. Where only pipe sewers enter the manhole at the higher elevations, the recess map be a bay extending a foot or two from one side and with vertical the upper pipe sewer merely extending through the wall of such bay and the sewage therefrom dropping down in such recess to the bottom of the manhole. This construction should be confined to house sewers only.

In the pipe drop, a vitrified pipe is attached to the outside of the manhole wall, entering through the wall at the bottom of the manhole by a bend of approximately 90 degrees. In the case of a combined sewer, this pipe is supposed to carry the dry-weather flow only, and the upper sewer is continued through an opening through the manhole wall, through which opening a considerable part of the storm water is discharged, the opening in the invert of the upper sewer by which it connects with the drop pipe serving as a leaping weir. If the upper sewer carries house sewage only, all of the sewage should drop through the drop pipe, but the line of the main sewer should be continued by an opening through the wall of the manhole to allow inspection and cleaning of the main sewer. "The advantage of this type lies in the dry-weather flow being confined entirely to the drop pipe, thus facilitating inspection of the manhole. The disadvantage is the liability of the bottom bend of the drop pipe becoming frequently obstructed; causing the flow to fall into the manhole proper, and requiring cleaning."

The chamber drop is similar to the pipe drop, except that a separate chamber takes the place of the pipe, ordinarily being constructed by building a curtain wall across the manhole near one side. This chamber is made of such dimensions as to permit the entrance of a man for inspection if occasion requires. This type, like the pipe drop, provides a dry chamber for inspection at all times. It is probably more economical for high drops than the recess type would be, but it is more costly than the pipe drop.

The cascade or ramp drop should not strictly be called a drop manhole, since it takes place over a considerable length of sewer, a manhole ordinarily being provided at about mid-length of the cascade. The cascade consists of a series of steps in the invert of the sewer, which are generally paved with granite or vitrified blocks. The ramp consists of a steep incline in the sewer without the steps. The use of steps was adopted in New York because they render the cleaning and interior examination of the sewer safer for the men and prevent development of such high velocities of sewage flow as would be developed with a ramp construction, thus reducing erosion of the lining of the sewer below the ramp.

WATER-POWERS AND INDUSTRIAL DEVELOPMENT*

By Leo G. Denis

Hydro-Electric Engineer, Commission of Conservation.

OUR water-powers and the part they will play in the readjustment of industrial conditions suggest various questions of vital importance to Canada. It would be presumptuous, at this stage, to predict their solution, or even to point to any definite course which should be followed; consequently the writer has confined himself to pointing out some of the principal steps required to secure the maximum of result, and to emphasizing the necessity for immediate action.

We Must Be Less Wasteful

The war has awakened Canadians to a realization of the natural resources of their country. It has thrown us back upon ourselves in a way which perhaps no other one thing could possibly have done. It has shown us we must be less wasteful in the use of our resources and must devote more attention to their more adequate development.

If we are to retain our place industrially, we must learn to do for ourselves what others have been doing for us. The time has surely arrived when we should work out our industrial independence and prepare for the industrial struggle that must follow the war; otherwise, it is more than likely we will lapse into our old helpless dependence and never realize our destiny of becoming a really great industrial nation.

It is impossible to state the definite total water-power potentiality for Canada. There are so many factors, such as allowance and facilities for artificial storage, or the adaptability of industries to seasonal fluctuation in the flow of streams. Various estimates for the Dominion have been made but all are of the nature of glorified guesses. One of the most recent estimates gives 25,000,000 h.p. as the total available water-power in Canada; another places the make-up total, exclusive of the North-west Territories, Yukon and Northern Quebec, at 17,746,000 h.p., not assuming the use of full storage possibilities; while a third estimate gives a total of over 13,000,000 h.p. for the three provinces of Ontario, Quebec and British Columbia alone.

Undeveloped Water-powers

Although the representative total for the whole of Canada is more or less uncertain, fairly definite figures are obtainable for numerous water-powers, which are, as yet, undeveloped, particularly those in the more settled southern portion of the Dominion.

The importance of our water-powers is shown in the rapidly increasing rate at which they are being utilized. As early as 1851, official records show 3,550 grist and sawmills operated by water-power in Upper Canada and Lower Canada alone. It is estimated that, in 1901, water-power utilized in the various industries for the entire Dominion amounted to 350,000 h.p., while, in 1911, a careful survey, made by the Commission of Conservation, revealed a total of 1,016,500 h.p. Estimates for 1915 show some 1,700,000 h.p. in use, and it may be taken for granted that the 2,000,000 horse-power mark has by now been reached.

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

Water-power versus Steam-power

In quoting figures on our utilized water-powers, it is customary to compare them with the cost of an equivalent amount of power produced from coal. This does not do full justice to our water-power, as many of the industries using it could not operate if compelled to use steam-generated power, while possibly the greater portion of those remaining would use imported coal, thus transferring to other countries the money value of the fuel used for power, which latter now remains in Canada.

The extent to which future utilization of our water-powers will enter into the industrial development of Canada will be measured by the energy and foresight of the various governments, particularly the federal authorities. In the past, we have relied too much upon the experience and investigations of other countries, trying, with more or less success, to adapt them to our conditions. In many cases, investigation work in connection with our water-powers and their utilization has been left to private interests; this has resulted in the acquirement by interested parties of a better knowledge of conditions than is available to those appointed to administer them for the public. Government engineers have often been handicapped by the lack of previous government investigation, as opposed to the thorough knowledge acquired by the engineers of parties interested in a proposed water-power project.

Systematic Water-power Investigations

The importance and necessity of further extending the systematic water-power investigations already initiated is fully realized. In organizing this work of investigation and research it will, no doubt, be under direct government control and guidance, but the splendid facilities offered by the laboratories of our universities and other institutions must also be utilized. The award of scholarships for research work on water-power development and industrial utilization would result in further valuable information.

The director of the research laboratory of one of the largest manufactories of electrical apparatus in the United States recently stated that, after the war, in many countries, a much more methodical and extended interest in, and support of, research will probably be found than existed before. The war has awakened renewed activity in the British Empire and elsewhere. The British Board of Education is putting forth a "scheme for the organization and development of scientific and industrial research," through a committee of the Privy Council and an advisory council, the latter to advise the committee of the council on

(1) Proposals for instituting specific researches.

(2) Proposals for establishing or developing special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades.

(3) The establishment and award of research studentships and fellowships.

Australia also proposes to establish an Institute of Science and Industries whose functions are:—

(1) To consider and initiate scientific researches in connection with, or for, the promotion of primary or secondary industries in the Commonwealth.

(2) The collection of industrial scientific information and the formation of a bureau for its dissemination amongst those engaged in industry.

(3) The establishment of national laboratories.

(4) The general control and administration of such laboratories when established.

(5) To promote the immediate utilization of existing institutions, whether federal or state, for the purposes of industrial scientific research.

(6) To make recommendations from time to time for the establishment or development of special institutions or departments of existing institutions for the scientific study of problems affecting particular industries and trades.

(7) The establishment and award of industrial research, studentships and fellowships, to include either travelling fellowships or fellowships attached to particular institutions.

(8) To direct attention to any new industries which might be profitably established in the Commonwealth.

(9) To keep in close touch with, and seek the aid of, all Commonwealth and state government departments, learned and professional societies, and private enterprises concerned with, or interested in, scientific industrial research.

(10) The co-ordination and direction of scientific investigation and of research and experimental work with a view to the prevention of undesirable overlapping of effort.

(11) To advise the several authorities as to the steps which should be taken for increasing the supply of workers competent to undertake scientific research.

(12) To recommend grants by the Commonwealth Government in aid of pure scientific research in existing institutions.

(13) To seek from time to time the co-operation of the educational authorities and scientific societies in the states with a view of advancing the teaching of science in schools, technical colleges and universities, where its teaching is determined upon by those authorities.

(14) To report annually and from time to time to Parliament.

Government Action re Research

The Japanese government has, during the past year, appropriated for a laboratory for physical and chemical research $1,000,000, to which the Emperor has added $500,000. The Canadian government has recently created an Advisory Council on Industrial and Scientific Research. Water-powers and their allied industries will, no doubt, be given the attention they deserve.

Water-power investigations may be divided into two classes, differentiated, in general, under the following heads:—

(1) The conversion of water-power to hydro-electric or other energy.

(2) The use or application of the converted energy to the best advantage under local conditions.

Under the first of these would come reconnaissance surveys, records of stream flow, evaporation, precipitation, and other climatic observations. Results of surveys and other information regarding undeveloped sites should be made available to the prospective power user. Recording the flow of streams should be extended to all rivers of importance, particularly those on which large water-powers might be developed. These records, when covering a period of seven years or more, are most essential in establishing the value and capacity of any water-power; without them, no competent engineer could recommend any expenditure of capital on an installation to develop the maximum power during the low-water season or at

other times. Detailed surveys of advantageous power sites, with designs for development projects, should also be included, together with estimated cost of works, installation and operation. Studies of storage and other conservation possibilities should offer a wide field. Most of our streams are characterized by a large seasonal variation of flow and the capacity of a development is often economically limited by the minimum flow; unless storage and artificial regulation of the flow is resorted to, water runs to waste during the greater portion of the year. Artificial storage of water is already provided in several of the provinces, but it should be extended.

Problems Peculiar to Canada

The solution of problems peculiar to Canada should be given attention. One of these is the conveying of the stored water to the point where it is to be used. During the winter season, the formation of ice and other difficulties resulting from low temperature are met with.

Testing and reporting on various classes of hydraulic and generating machinery and auxiliary apparatus, such as governors, regulators, etc., might also come under this head.

While many British Columbia water-powers offer natural high heads, those in the other provinces have, usually, relatively low heads, therefore, research conducive to reduction in cost of low head developments would benefit Canada.

Irrigation and Water-power

The relation between irrigation and water-power development in the western "dry belt" offers conditions dissimilar to those of other countries; these require special investigation. In the United States, an important use of hydro-electric energy is in pumping water for irrigation purposes, and, while this may never become of great interest to Canada, we may anticipate the construction of joint undertakings using the same site and the same works intermittently for irrigation and water-power purposes. Water, which would be used for irrigation only at the periodical recurrence of a dry year, can be utilized for water-power purposes at other times. This is demonstrated by crop results of 1914 and 1915 from the same semi-arid area in Western Canada. The failure of 1914 was changed to a bountiful harvest in the next year, by about eight inches more rainfall in the growing season.

Disposal of Water-powers

The legal aspect of the disposal of our water-powers is important. The general principles incorporated in our legislation have now become fairly uniform in the different provinces, including the leasing instead of disposition of water-power rights in fee, their development and utilization within a reasonable period, and remuneration to the Crown, which latter, however, should not be a principal object in disposing of water-power. These are all sound principles, and should be maintained, but the details should, if necessary, be changed to secure better results. In the eastern provinces, particularly, most of the water-powers in the settled portions have passed to private ownership; many of them are lying idle and are held by the owners for speculative purposes, or to avert competition. Owners on one side of the river have sometimes been prevented from developing by owners of the portion of the fall on the other side of mid-channel. This condition should be remedied, as water-powers in the more settled portions should naturally be harnessed first for the benefit of industries. Steps should be taken to release water-powers owned by parties having no intention of developing.

Canada's share in all boundary water-powers should be assured. These occur in the more thickly populated and settled portions and are essential to industrial development. They should be fully investigated and definite projects and detailed plans of construction for their development approved. These plans should then be strictly adhered to by prospective users, which would not only assure its proper share to each country, but, particularly, where several concentration sites are possible on the same river, co-ordination and non-interference would be secured. Large enterprises at Niagara, endeavoring to develop additional power, have again directed attention to boundary waters. In every case of original or additional boundary water-power development, Canada's share should be safeguarded before the plans are given approval; otherwise this country might lose, probably for ever, a portion of natural power facilities.

Application of Electric Energy

The investigations under the second head relate to the application of the energy derived from our water-powers to an economic end, for the benefit of Canada. While intimately connected with the first, this phase is of even greater moment—the most elaborate system of water-power development would prove valueless if not extended to yield a marketable product. Numerous problems, however, will arise, particularly in connection with the intermittent use of power as applicable to certain industries. This is well illustrated by a hydro-electric plant near Duluth, Minn., where fully one-half of the energy generated is delivered to a single electro-chemical works. Under arrangements to use intermittent power, practically all surplus energy is utilized, resulting in a load factor of about 90 per cent. The chemical company is notified as to the available power and adjusts its furnaces accordingly, thus securing the advantage of a cheap and plentiful supply.

Electro-chemistry and Metallurgy

The use of hydro-electric energy in electro-chemical and metallurgical processes is generally considered the most advantageous use of water-power. These industries, however, comprise many branches, each offering many different processes, and it is essential, through investigation, to ascertain which of these would be of the greatest benefit to Canadian conditions. If known processes are unsuitable, investigation and research should reveal others which will be profitable to this country.

While local conditions may point to the direct application of water-power, such as in the wood-pulp, paper and lumber industries, the use of electricity as a medium should produce the greater development. The intimate connection between the harnessing of streams and the production of electric energy is recognized, and, if the latter is included in our field, as it should be, we have almost unlimited possibilities. Electricity is one of the greatest potent factors of the universe: First, in its distribution, far and near, for the benefit of domestic life, but, perhaps even more so, in its various industrial applications, whether to produce light, motion, chemical action, or various degrees of heat.

Hydro-electric Development

Canada is by no means backward in hydro-electric development. With but few exceptions, all our principal

cities and by far the greater number of our towns and villages are supplied with hydro-electric energy, while the electro-chemical industries centred at Niagara, Shawinigan and elsewhere evidence the development in that direction. Nevertheless, with proper direction and encouragement this could be greatly increased. An example of this is given in the electro-chemical field, where, although exact figures are not available, it is safe to say that more hydro-electric energy is exported for this industry than is used in Canada for the same purpose.

Control of Power Export

The question of power export has become very acute, and no export licenses should be granted except when unavoidable. Canada secures little benefit from this exported power, as, once a plant is in operation, the benefit derived from an installation generating the enormous quantity of 100,000 or 200,000 h.p.—exclusive of the small taxation and export charges—would be represented by the earnings of a staff of a dozen attendants.

Industries in which the cost of power is but a small factor in the total cost of production do not benefit greatly from cheap power. While cheap power is an attraction to all industries, other things being equal, those requiring the largest amount, figured on a basis of the value of their product, will naturally be more interested.

Power-using Industries

The following table, prepared from both Canadian and United States census reports and various other sources, is of interest in this connection. It shows the amount of power required, in the industries enumerated, to produce $1,000 worth of product during one year. The larger this amount, the greater need of cheap power for the industry.

Industry.	H.P. required for every $1,000 produced per year.
*Mechanical wood pulp	16.93
*Aluminum	16.00
*Calcium carbide	15.39
†Cement	7.08
†Log products	2.95
†Brick, tile and pottery	2.28
†Iron and steel products	1.98
†Cottons	1.97
‡Cement	5.91
‡Paper and wood pulp	4.87
‡Kaolin and ground earth	4.47
‡Brick and tile	3.67
‡Flax and hemp, dressed	2.46
‡Lumber products	2.46
‡Cottons	2.07

*Data from various sources.
†Data from Canadian census.
‡Data from United States census.

The manufacture of carborundum, of nitric acid, of nitrate fertilizers from the nitrogen of the air, and of graphite in electric furnaces, all require large amounts of power.

Recent papers, read before the American Institute of Electrical Engineers, and dealing with the connection between water-powers and various industries, point out that industrial processes founded upon electro-chemistry have a part in the manufacture of a very wide range of commercial products.

Electro-chemical Processes

Electro-chemical processes have entered into some phase, at least, of nearly every branch of our industrial life. From a small beginning in electroplating two generations ago, much the greater portion of the copper output of the world is now electrolytically refined; zinc and tin so refined are also in the market. Electrolytic refining increases the purity of the metal and also makes possible the recovery of the impurities as by-products, thus greatly cheapening the cost of refining.

Electrolysis of common salt forms the basis of the electrolytic alkali industry, the products of which are caustic soda, the starting point for various chemical industries; metallic sodium, also used as a foundation for other products, such as the cyanide so largely used in the metallurgy of silver and gold, chlorates, used in the manufacture of matches, certain explosives, etc., hypochlorites, of value for bleaching, and chlorine, employed as a sterilizing agent.

Electric Furnace Products

Many new industries have been created by the electric furnace, some of the products of which are abrasives, graphite, silicon, ferro-alloys, refined steel, phosphorus, calcium carbide, used in the generation of acetylene, and in the manufacture of cyanamide; it is also being experimented with in the metallurgy of many metals. Used as an electrolytic furnace, it becomes an important application to the production of aluminum.

Electric furnace processes all consume large quantities of energy; an ordinary melting operation, such as casting an alloy or refining steel, usually requires from 600 to 1,000 kw.h. per ton. In the production of ferro-alloys the power used varies from 3,000 to 8,000 kw.h. per ton of product; the aluminum furnace requires 25,000 kw.h. per ton of product.

The industrial use of electric discharges through gases is still in its infancy, but among the products are ozone and nitric acid, the former used for sterilization and the latter as a base for fertilizers and explosives.

Production of Nitrogen

The production of some of the most highly nitrogenous food products has been steadily declining and Canadian and United States farmers have been producing less per acre than European farmers. In the last analysis, the food supply depends upon the plant food supply. The production of nitrogen, which is one of the three principal fertilizer ingredients, is distinctly a water-power proposition, involving the fixation of atmospheric nitrogen.

Each of the processes under consideration has advantages. The problem is many-sided and far-reaching, and hence it is very desirable that the various government departments concerned should co-operate in determining the most advantageous.

Those not familiar with conditions in the electro-chemical industry commonly put all electro-chemical industries in one class as power consumers. They are, however, extremely diverse, their requirements in power, and the relative importance of the factors of power, labor and other items are also extremely diverse.

The electro-chemical industries have already become of great value to Canada and, in the utilization of water-power resources, will become far more so; they have a fundamental interest in the development of cheap power,

which can only be obtained by the harnessing of streams and they offer nearly ideal power loads of magnitude. In view of this it seems evident that organized research work to extend their present relatively limited field would prove of great benefit to the country.

Electricity as Motive Power

While not so apparent, as in the case of the special processes using large quantities of electric energy, the latter plays an important part in many of our other industries. As a motive power it is easily applied and distributed, and, under certain conditions of operation, it is much cheaper than any other form of power. Its convenience and economy is well illustrated by the fact that, even where coal is used as a primary agent, innumerable cases are in evidence where conversion to electric energy is first resorted to, before application to the various contrivances to be operated. Electric energy used as a source of heat is also an important factor in the manufacture of many products, and some 35 or 40 industries use it extensively in such applications as electric welding, melting tanks, soldering devices, tempering baths, annealing furnaces, and various types of self-heated tools.

The necessity for government investigation, surveys and research work in connection with our water-powers and their industrial application was demonstrated in the recent controversy between United States government officials and the electrical corporation interests. One of the arguments advanced by the latter was that too much intrinsic value should not be given to latent water-powers, as enterprises connected with their development and utilization presented unusual risks, owing to the many unknown quantities involved. Let us then prepare to refute such arguments in Canada, by reducing these unknown quantities to a minimum. How much more valuable and attractive to capital would our water-powers be if we were able to say, not only that such a water-power will cost, approximately, so much to develop but to demonstrate that the energy derived therefrom may be utilized profitably in certain definite industries?

Lancaster, England, is contemplating a large scheme for increasing its water supply, comprising the construction of three storage reservoirs at Langthwaite (to hold 135,000,000 gallons), Lower Damas Gill (100,000,000 gallons), and Sparrow Gill (200,000,000 gallons), and an additional compensation reservoir at Wyrehead, capacity of 135,000,000 gallons. Another line of pipes will also be laid. The cost of the works alone is estimated at £400,000, and it is proposed that the first instalment of the scheme, which will probably cost £250,000, should include the construction of the new compensation reservoir and one new storage reservoir, the present storage accommodation being confined to Damas Gill (35,000,000) and Blea Tarn (126,000,000 gallons).

According to a report issued by the American Highway Association, a contractor on a Pennsylvania road has completed his work at a lower cost than was attained on other sections of the road by using machinery to an unusual extent. On account of the high price of labor and its scarcity in that section, he used a steam shovel in all cuts, low-strength dynamite to loosen the material and speed up the work of the shovel, and automatic dump wagons to remove the earth and shale as it was excavated. The outfall drainage ditches were blasted out with dynamite, thereby reducing the cost of excavation and trimming the slopes. The work was finished on time in addition to being done at a relatively low figure for the conditions, while the other contractors were unable to finish on time on account of the difficulty of securing labor to carry on the work by the older methods utilizing merely plows, scrapers and hand work.

DETENTION RESERVOIRS WITH SPILLWAY OUTLETS AS AN AGENCY IN FLOOD CONTROL*

By Brig.-Gen. H. M. Chittenden, M.Am.Soc.C.E.

A DETENTION reservoir is one formed by a natural or artificial engorgement in the valley of a stream whereby the volume of water which may pass for a given depth in a given time is strictly limited. The surplus which cannot thus pass in time of heavy flow accumulates in the basin above the engorgement and flows out as the inflow decreases. The function is purely automatic, human control being wholly eliminated. The effect is to prolong the period in which an excessive run-off passes the point of engorgement and to reduce proportionally the rate of discharge in the valley immediately below.

The engorgement may be produced in a variety of ways, as by the contraction of a natural chasm, by the construction of a dam with one or more conduits through the base, or by the construction of a dam with a spillway at some level above the base. In the first two cases the accumulated excess flows out entirely after the flood is past and the basin above is left empty. In the third case there will remain a body of water in the basin after the spillway has performed its alloted function. Although the first two types will be referred to frequently in this paper, only the third will be given special consideration, as it is the type which seems to be adaptable in some degree to the compromise of conflict referred to in Section 1 of this paper.

A brief reference to the terminology of the subject may properly be made at this point. The terms "detention reservoir" or "detention basin," "retarding basin," "restraining reservoir," "impeding reservoir," have been used in official discussions of the subject. There is one defect common to all these terms, except possibly the third, and that is this—they do not suggest the end for which the system is designed, but only the means of attaining that end. Reduction of flood discharge is the great desideratum, but there is no hint of this in three of the foregoing terms. The terms "reduction" or "restriction" would be more appropriate, but there is something about these words that does not appeal to the ear. The term "restraining" carries a suggestion of both end and means, is in itself an agreeable descriptive, and perhaps fills all the requirements better than any other term that could be selected. Common use, however, is the final arbiter of all questions of this sort, and, on this basis, "detention reservoir" has the lead, notwithstanding the great prominence given to "retarding basin" by its use in the Official Plan of the Miami Conservancy District. As between "basin" and "reservoir," the writer distinctly prefers the latter, except in those cases where the basin itself and not its content is specifically referred to. As the agencies herein discussed are in the most literal sense reservoirs, "detention reservoir" is definitely adopted in this paper.

The term "dry reservoir" appeals to the writer as a most happy descriptive of that particular type of detention reservoir in which the detained excess of run-off runs out soon after the crisis of the flood, leaving the basin above the engorgement empty or dry. The original detention reservoir formed by the *Digue de Pinay* in France more

*Abstract of paper presented before American Society of Civil Engineers, October 17th, 1917.

than two centuries ago was of this type, as are also to be all the units of the Miami system.

The Spillway: Definition and Description

In its ordinary use the spillway is a device for conveying, over or through the crest of a dam, the surplus inflow from above in such a way as not to endanger the integrity of the dam. Its purpose is negative rather than positive. It plays no active part in the dynamic functions of the dam, as a penstock and other appurtenances do, but simply stands guard to see that the dam shall not be wrecked by any inflow in excess of that which its purpose of utility requires.

The successful operation of the spillway requires that it satisfy three vital conditions. It must have sufficient capacity to prevent overflow of the dam, because such overflow is always dangerous, and, in the case of earthen dams, fatal unless promptly checked. The spillway must have sufficient structural resistance to withstand the tremendous strain of deep overflow. Means must also be provided at the point where the overflow strikes the level of the stream below to neutralize the energy developed in its fall without danger of undermining the dam. Inadequate satisfaction of these conditions is more common than the engineering profession likes to admit, and Professor Mead very properly says that "perhaps there has been no more frequent cause of the failure of dams than inadequate spillways."

Inasmuch as the spillway requires a certain depth of overflow to be effective, and as it sometimes happens that the resulting elevation of water surface above the dam may be objectionable, the escape of water in such cases may be accelerated by the use of sluiceways, movable gates, flash-boards, and similar devices, all of which are under direct control. These serve the primary purpose of the spillway in facilitating the escape of surplus water, but lack the automatic character which is a distinctive feature of the true spillway.

The writer has defined the spillway, in the common acceptation of the term, as a safety device pure and simple. In the following discussion he will treat of it under a somewhat broader conception—one based not at all, or at least only incidentally, on the negative consideration of safety, but on positive considerations of utility. It will fulfil a vital function in the purpose of the dam as an agency of flood control, and will be a direct means of extending the application of the detention principle to cases heretofore considered of doubtful feasibility.

Elements of Control

As a preliminary to this section, it may be observed that the combined function of dam and spillway which denotes the true detention principle is universally exemplified in nature. In almost infinite combination its elements of control may be found in actual operation. Every lake or pond which has an outlet is a case in point.

It is manifest that the moderating effect of detention reservoirs, whether natural or artificial, is the combined result of three co-operating factors, two of which are, or may be made, subject to artificial control, but the third is not. These are the storage capacity of the reservoir per unit depth at any level, the spillway capacity per unit length, and the duration of the flood wave. In perfectly general terms, this moderating effect increases with the area of the reservoir and diminishes as the length of the spillway, or the duration of the freshet, increases; but these variations in result never follow in exact ratio the variations in the factors which produce them. In some conditions the correspondence is close, in others it is widely divergent.

Assume first fixed conditions as to spillway length, and as to duration and volume of flood wave or inflow into the reservoir. The moderating effect of the reservoir would increase with an increase of area, but, as a rule, in slightly greater ratio. For example, with an area in one case twice as great as in another, the same quantity of storage would raise the larger surface half as much as it would the smaller, if the outflow in both cases was the same; but the outflow would not be the same. The flow over a spillway increases in faster ratio than the depth—generally much faster—and to cut off half the depth from the top would reduce the outflow by more than half. This is slightly compensated, however, in increased storage and elevation of surface due to restricted outflow; but, unless the spillway is relatively large, this effect would be small, and the reduction of outflow would remain more than half.

With fixed conditions as to area, volume, and duration of flood wave, the regulative effect will diminish with an increase in length of spillway, but in somewhat less ratio, because the greater outflow will diminish the height to which the reservoir surface will rise and consequently the outflow per unit length of spillway. Thus, if the spillway were doubled in length, the outflow, with fixed conditions as to the other factors, would be something less than doubled.

Much more difficult to follow than either of the foregoing cases is the effect of variations in the time factor, or the duration of inflow into the reservoir. It can only be stated, as a general proposition, that the regulative effect on the flood wave of given volume is greater as its duration is less; but there are so many qualifying conditions—as, for example, the relative size of spillway and the distribution of inflow during the freshet period—that no conclusion of general applicability seems possible.

Indeed, the whole problem of the inter-relation of these several factors seems to be too complicated to be expressed in any general formula which will embrace them all, and it seems destined to remain simply a problem in "particular cases"—the making of specific assumptions, and the determination of each group by itself. That is what would be done in practice anyway, but it would be a satisfaction, nevertheless, to have a general formula.

Prevalence of the Reservoir Idea

In passing from the general principles just discussed to their specific application, it may be stated at the outset that there is a deep-seated belief in the lay mind, and to a less extent in the mind of the expert, that in reservoirs is to be found the solution of the flood problem. As the writer stated some twenty years ago: "To store the surplus water in the flood season and use it in the season of drought ought, apparently, to strike at the root of the whole difficulty. * * * Why so obvious a remedy has never yet been extensively applied," the writer at that time traced to a prohibitory disproportion between cost and resulting benefits. Although this is true, as a broad generalization, it will be more useful to the student of these questions to give some of the specific details on which the generalization rests. They may be summarized briefly as follows:

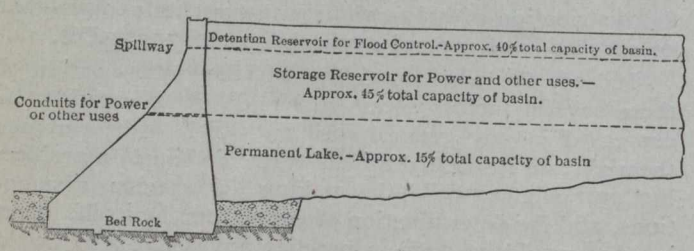
Deficiency of Sites.—This sometimes arises from an actual absence of physical sites, but more often from the lack of those which are economically feasible. Along the main valleys of the lower Ohio, Missouri and Mississippi there are no sites whatever into which the main streams

could be poured, except possibly to a small extent the overflow basins along the Mississippi. On the other hand, on almost any of the upper tributaries may be found physically practicable sites of sufficient capacity, if properly developed, to insure effective flood control. To-day, however, many of these sites are crossed by important railway systems which cannot be well re-located, or are occupied by villages and cities, rich and highly developed farms, mineral properties, etc., and, of course, almost all are traversed by public highways. It thus results that the occupancy of such sites for reservoir purposes, though physically practicable, is often economically prohibitory.

As a flood control measure, pure and simple, a reservoir may be only a trade-off, with the balance sheet against it. To quote again from the writer's early reservoir report (p. 46):—

"Floods are only occasional calamities at worst. Probably on the majority of streams destructive floods do not occur, on the average, oftener than once in five years. Every reservoir built for the purposes of flood protection alone would mean the dedication of so much land to a condition of permanent overflow in order that three or four times as much might be redeemed from occasional overflow. One acre permanently inundated to rescue three or four acres from inundation of a few weeks once in three or four years, and this at a great cost, could not be considered a wise proceeding, no matter how practicable it might be from engineering considerations alone."

It will conduce to a clearer presentation of the subject if we assume what may be called an ideal example, setting forth its possible development on the foregoing lines, and then noting the qualifying conditions which must often interfere with such development, and compel its abandonment or the acceptance of something less than the highest result. Suppose (Fig. 1) that there exists a practicable reservoir site in the valley of an important stream; that industrial and other uses in the valley can profitably utilize all the flow of the stream which could be made available; and that flood conditions in the valley are such as to justify extensive measures of relief. Let it be assumed that public authority, State or Federal, has been given the right to supervise reservoir construction, and to see that it is planned, if desirable, so as to serve all the purposes of which the development is capable.



Illustrating "Ideal" Combination of Reservoir Uses.

The first consideration would be the requirements of use. It would be necessary to determine a storage capacity sufficient to equalize the flow of the stream, at least to its mean annual volume. It might indeed be very useful to do more than this, and make the excessive run-off of some years offset the deficiency of others. If it were planned to put in a power plant immediately at the base of the dam, or at least where it could utilize the head created by that structure, it might be of advantage to make the dam permanently tight to a considerable elevation. This would insure a minimum head to be relied on at all times, and would greatly reduce the range of annual fluctuation and the resulting differences in head. With all conditions of the problem fully considered, the storage capacity would be determined, and with it the maximum level for this part of the reservoir.

The spillway would be placed at the maximum storage level just determined. The flood-control problem would then be worked out, based on the most extreme assumptions that could reasonably be made. The additional height of dam, and the spillway capacity necessary to secure the desired control, would follow, and the full dimensions of the dam would thus be determined. The portion of the reservoir below the spillway would be subject to human control; that above would not. The super-reservoir would really be of the dry type, because all that portion of the basin above the spillway level would drain out promptly after the passage of a flood, and would remain dry most of the time.

EFFECT OF CREOSOTED WOOD STAVE PIPE UPON WATER FOR DOMESTIC AND IRRIGATIONAL USES

Experiments to determine the effect of creosoting on the quality of water passing through wood stave pipe have been made recently by the Bureau of Industrial Research of the University of Washington. The tests to determine the effect upon the potability of water passing through the pipe were made with a 48-ft. section of 4-in. creosoted Douglas fir stave pipe. The treatment was 16 lbs. of creosote per cubic foot of wood. In the experiment the water was circulated through the pipe for 6 hours at a velocity of 5 ft. per second before taking each sample. The taste of the water was accepted as evidence of its potability. It was found that after the experimental pipe line had been in service for 13 days, no taste of creosote could be detected in a sample of the water diluted with two parts of ordinary city water. After the experimental pipe line had been in service for 29 days, no taste of creosote could be detected in undiluted water flowing through it.

The test was extended to determine the effect of minute quantities of creosote upon the availability of the water in irrigation. The conclusion reached as the result of the test was:—

The amount of creosote that diffuses into water in ordinary creosoted pipes does not have an appreciable injurious effect upon plants either in the time of germination, the percentage of germination, the rapidity of growth or the general vigor of the plant.

The British Trade Commissioner in Australia, after visiting the Broken Hill steel works, Newcastle, N.S.W., reports that large quantities of rails have been turned out, principally for the Government railway between Port Augusta and Kalgoorlie. The demand for rails has been so great that the company has found it impossible to carry out its intention of rolling plates and sheets. Channel sections are being rolled to the order of the New South Wales Government. Before the war practically all such sections were imported from Europe. The company, it is stated, can roll 4-ft. plate for its own use, but is not in a position to roll 5-ft. plate, the most suitable size for shipbuilding. It is thought, however, that it may be possible to utilize 4-ft. plate for shipbuilding, and if this can be done one of the hindrances to the development of the shipbuilding industry in the Commonwealth will be overcome. Other prospective developments in connection with the steel works include wire drawing and the manufacture of wire nails.

NEW FEATURES IN CHARTER OF WATER BOARD*

By Scotland G. Highland
General Manager of Clarksburg Water Works and Sewerage Board.

IN my humble judgment every municipal water department should be conducted as a separate "administrative entity" and should be entirely separated from the general city government. Such a policy necessitates the conferring of broad and extensive powers upon the administrative body such as are usually exercised by a private corporation engaged in supplying water for public uses.

The city of Clarksburg, W. Va., has created an administrative board and submitted to its government the entire authority of constructing and operating the municipal water plant and system. The powers conferred upon this administrative board are briefly shown in the quotations from the charter appended to this article.

The division of authority between the body administrating the water plant and the officers conducting the general city government, has not proved workable and does not contribute to efficiency in either department. The business of supplying water when conducted by a municipality is first and always, only a business and should be managed and conducted solely as a business, not for the purpose of obtaining the largest possible revenue but to attain the greatest possible efficiency and to supply, at a moderate charge, all public requirements. Being a business, questions of general public policy and civic improvement, ethical and moral laws and regulations find no proper place in the operations of a water system. The persons chosen for constructing and operating a municipal water plant should always be chosen for their technical knowledge of the particular enterprise which is to be committed to their charge. Knowledge of the broader questions of municipal government in no way qualifies individuals without the technical knowledge to successfully operate a waterworks system.

An attempt to operate the water system of plant as a distinct part or branch of a general scheme of municipal government, whether that government be conducted by a political body elected in the manner generally prevailing or by commissioners under some modification of the city management plan, will usually fail of achieving the efficiency which otherwise would be obtainable for the reason that general city officers or the officers conducting the general city government, are chosen from time to time upon issues involving questions of ethics and morality and the general policy of the government which has no relation whatever to the business of managing the water system. Upon such issues, the people divide and give effect to the particular policy or scheme of municipal government which, for the moment, is the most popular. The experience of the candidates for city offices in conducting a "business" enterprise, forms no part of the general debate and is not passed upon by the city electorate in choosing officers. From the very nature and fundamentals of the usual city administrative body, the officers chosen by the people to conduct the general city government rarely possess technical knowledge or experience in any given line of business. This results in loss to those branches of the municipal government which are purely "business" in their nature.

The reasons briefly outlined, led the municipality of Clarksburg to take steps to separate entirely the construction and management of its waterworks plant and system from the general scheme of the municipal government and to place it under the control of a governing body to be chosen solely because of their qualifications to conduct that particular business. A vote cast in selecting a member of the administrative body which controls the waterworks system, does not, in any way, reflect the sentiments of the voters on ethical and moral questions or questions of general public policy in the administration of the general city government. The choice is based entirely upon the qualifications of the party voted for, to conduct that one particular business. The result of this scheme is that experts, possessing technical and general knowledge of the subject, are placed in charge of an enterprise that is of a strictly business character and a degree of efficiency is obtained in administering the particular business which has not generally prevailed in municipal governments throughout the country.

Brief Excerpts from Charter

Sec. 30. The Clarksburg, West Virginia, Water Board herein created when this act goes into effect, shall supersede the waterworks and sewerage board created by chapter twelve of the acts of the West Virginia Legislature, session one thousand nine hundred and nine. The water board shall at its first meeting, or as soon as practicable thereafter, appoint a general manager for the waterworks plant and system of the city. The general manager shall act as secretary for the water board, and shall be treasurer of the water board. Said board shall have the power to employ such hydraulic engineers, mechanical engineers, and other technical experts, attorneys, assistants, agents or other employees, as they shall at any time deem necessary for the good of the public service. They may create, fill and discontinue employments other than those herein prescribed, according to their judgment of the needs of the department.

Department of waterworks shall be "an administrative entity" separated from the general city government and administered by the water board, elected for a term of three years. Effective November 1, 1917.

Powers of the Water Board

Sec. 82. In order to prevent the pollution of the waters from which the people of the city take water for domestic uses, the jurisdiction of the water board shall be co-extensive with the location and extent of the waters from which such supply is taken, except that in no event shall such jurisdiction exist within any other incorporated city or town.

Sec. 29. Power of Eminent Domain.—The water board as herein created shall have the right under the power of eminent domain to condemn, acquire and appropriate any property and acquire the fee simple title or any lesser estate or easement therein for any public use, whether said property be located within or outside of the corporate limits of said city, including the right to acquire property for the construction and maintenance of sewer lines, sewage disposal plants, water lines and mains, pump stations, reservoirs or reservoir sites, dams for storing water, and the right to create storage reservoirs by flooding adjacent properties, and for every other purpose required in the construction, maintenance and operation of water systems and plants for the purpose of supplying water to the public. The proceedings to acquire such lands, estates, or easements shall be the same as provided by general laws of the state of West Virginia for condemning and appropriating private property for a public use.

Power to fix and regulate rates and charges; to fix penalties for failure to pay promptly; to charge water

*Paper read before the American Water Works Association.

rentals directly to owner of property; to charge cost of installing services against land owner and require payment in advance; to install water service lines prior to street paving and charge cost to land owner:—

(*a*) The water board is empowered to fix, regulate and change rates and charges for water supplied to all consumers, and to adopt and prescribe rules and regulations which shall be observed and obeyed by all consumers in reference to the use and consumption of water taken from the city mains; the terms and conditions upon which connections to the said mains shall be permitted, and the place and manner of making the same; to fix penalties by way of additional charges for failure to pay water rents promptly, and to this end may discontinue the supply of water of any consumer who fails to pay for the same as required; to require all users of water for temporary purposes to pay for the privilege in advance; to refuse to furnish water to any building or habitation in the city unless the owner thereof shall assume liability for the payment of the charges for the water so furnished; to charge the cost of installing water service lines from the curb line to the mains against the land owner, and to require the payment in advance for installing such line and making connection with the water main; whenever the city council shall determine to pave or repave any street in the city, the water board is authorized to make a proper connection and lay a water service line from the main to the curb for each and every lot or for any part of a lot under separate ownership, although no water service may at the time be necessary or required for any such lot or part of lot, and to charge the cost of making such connection and laying such water service line against the owner of the property, and the cost of laying such water service lines and making such connections shall in every instance be a lien upon the lot or part of lot to be benefited thereby, and the water board shall have the right in the name of the city to institute and prosecute any proper suit in the circuit court of Harrison County, West Virginia, for the collection of such charges by a sale of the property on which the same constitutes a lien.

Plumbers Required to Pass Examination and Obtain Certificate of Competence

(*j*) The city may require all persons who engage in the business of plumbing to pass an examination and obtain a license or certificate for such purpose. For this purpose there is here created a board of examiners of four persons to consist of the superintendent of public welfare and the general manager of the water board and of two other persons selected by them, one of whom shall be a master plumber and the other a journeyman plumber. The license shall be for such term or period as may be prescribed by the examining board. The superintendent of the department of public welfare and the general manager of the water board shall not receive any compensation for serving on the board of examiners, but the additional members shall be entitled to a sum not exceeding five dollars per day for each day of actual service, to be paid out of the funds of the water board. The general manager of the water board shall be *ex officio* secretary of the board of examiners, and he shall make out and certify, and the superintendent of the department of public welfare shall countersign, all certificates of licenses, and said secretary shall keep and preserve all papers and records relating to the work of said board. The board shall be governed by any ordinance in force in the existing city of Clarksburg when this act goes into effect, or which may be passed by the Water Board.

FILTRATION PLANT AT AYLMER, P.Q.

(*Continued from page 377.*)

use of four cubic feet of free air per minute, under 3½ pounds pressure. The effluent controllers are designed to vary the rate 25 per cent. either way from the normal, 333,000 U.S. gallons in 24 hours.

As an extra precaution, and conforming to modern practice, the Aylmer filter plant is also provided with an apparatus for adding chlorine to the water. The particular apparatus installed is of the Wallace & Tiernan make, known as their manual control chlorinator, solution feed, type "A". This apparatus controls and accurately measures the flow of liquid chlorine from steel containers to the water suction of the high-lift pumps. This apparatus is particularly interesting. The pulsating meter is capable of feeding at the rate of one pound of chlorine in twenty-four hours, which would equal .000694 pound per minute, a quantity so small that it is hardly conceivable. While the plant has not yet been officially tested it is probable that the quantity of chlorine that it will be necessary to add to the filtered effluent, in order to turn out a practically sterile water, will not exceed two-tenths of a part per million.

The new high-lift pumping unit consists of one direct connected, motor-driven, two-stage centrifugal pump, having a capacity of 700 U.S. gallons per minute. This pump replaces one of the old original steam reciprocating pumps. Its suction is connected to the clear-water basin and also to the raw-water intake. This is true also of the remaining old steam reciprocating pump. Therefore, the high-lift pumping machinery, both steam and motor-driven, can be operated and pump filtered water, or in case of necessity can pump raw water.

The cost of the plant was approximately $38,000. The contract was carried out under the direction of Orr Wilson for R. T. Smith & Co., Victor A. Fournier for the New York Continental Jewell Filtration Co., and Mr. Allee as erecting engineer for the filter company, all work being under the supervision of Jas. O. Meadows as consulting engineer for the town.

TO IMPROVE HAMILTON

Noulan Cauchon, C.E., of Ottawa, addressed the Hamilton Town Planning Commission last week, outlining a programme for increasing the attractions of Hamilton. Mr. Cauchon said that the mountain-top should be annexed by the city without delay, and used as a residential table land, with the installation of proper sanitary facilities.

There are natural parks in Hamilton which should be developed to the utmost. Dundas should be absorbed, said the speaker. The marsh should be drained and developed for an aviation campus. A sluice gate should be installed in the Desjardins Canal. Red Hill Creek Valley and Chedoke Valley should be secured for parkways. A harbor driveway should extend along the entire north shore of the bay.

Mr. Cauchon urged that Hamilton should co-operate with the municipalities in the Grand River Valley, as well as the Niagara municipalities, stating that great opportunity exists for a co-operative plan to unify the whole district under a town planning scheme. Mr. Cauchon later addressed a meeting of citizens of Paris, Galt, Preston and Waterloo at Kitchener, Ont., with reference to this scheme.

The Canadian Engineer

Established 1893

A Weekly Paper for Canadian Civil Engineers and Contractors

Terms of Subscription, postpaid to any address:

One Year	Six Months	Three Months	Single Copies
$3.00	$1.75	$1.00	10c.

Published every Thursday by
The Monetary Times Printing Co. of Canada, Limited

JAMES J. SALMOND, President and General Manager — *ALBERT E. JENNINGS*, Assistant General Manager

HEAD OFFICE: 62 CHURCH STREET, TORONTO, ONT.
Telephone, Main 7404. Cable Address, "Engineer, Toronto."
Western Canada Office: 1208 McArthur Bldg., Winnipeg. G. W. GOODALL, Mgr.

PRINCIPAL CONTENTS OF THIS ISSUE

U.S.A. AND THE QUEBEC BRIDGE

United States Consul W. Roderick Dorsey, of Quebec, P.Q., is impressed with the credit due the United States in the construction of the Quebec Bridge. In a letter dated October 3rd, addressed to the Department of Commerce at Washington, D.C., which that department printed in its official "Commerce Reports" for Monday, October 15th, Consul Dorsey says:—

"The United States has played an important rôle in the successful carrying out of the (Quebec Bridge) project. Much material and skill that went into the work originated across the border. One great steel plant in the United States is said to have manufactured all structural steel shapes, plates, and bars, including carbon and nickel steel, while another American company supplied the reinforcement used in the concrete sidewalks. The chief engineer during the construction of the cantilevers was an American, and both the engineer of construction and the superintendent of erection throughout the work, as well as several assistant engineers and skilled mechanics, were citizens of the United States."

We quite understand Consul Dorsey's pride in the enterprise. There is no doubt but that much material for the Quebec Bridge came from the United States; and many of the workmen were United States citizens. United States engineering firms and United States engineers have played a greater or lesser part in very many great Canadian enterprises. Geographically, that is only natural. The methods, ideals, capabilities and aims of United States engineers and engineering firms are very similar to those of Canada, and it is but natural that they should work side by side with us. As our allies and our brothers in the advancement of civilization, we welcome their aid and co-operation at any and all times, but they can hardly claim the degree of credit for the Quebec Bridge which Consul Dorsey implies. Assistance was indeed rendered, but no one appreciates better than the United States engineers that the part which they played in the Quebec Bridge was purely a matter of assistance. The Quebec Bridge is a Canadian engineering project, beyond question.

The chief engineer, Mr. George Herrick Duggan, is not an American, as stated by Consul Dorsey, but, as is well known, is a Canadian born and bred. Mr. Phelps Johnson and Mr. Duggan are the men who are the responsible heads of the Quebec Bridge design and construction. Working under the direction of Mr. Phelps Johnson as the executive head, Mr. Duggan was the chief engineer of the enterprise in every meaning of the title, and to him must go the engineering credit for the bold and successful carrying out of Mr. Johnson's K-truss system.

C.N.R. PURCHASE

Official information has reached *The Canadian Engineer* that a maximum limit will be set by the government upon the amount which the arbitrators may pay for the Canadian Northern Railway Company's shares to be acquired under the act passed at the recent session of parliament. Should the arbitrators award a larger amount than the maximum named in the agreement, Mackenzie & Mann will either accept the maximum or further reference to parliament may be allowed. The agreement in which this amount is stipulated has not yet been finally approved by the government, but daily newspaper reports from Ottawa state that the maximum is $10,000,000, and that the draft order-in-council has been prepared and awaits ratification by the Cabinet.

Readers of this paper will no doubt recall that our chief objection to the government's plan of taking over the C.N.R. was the fact that no maximum limit was placed on the amount which the arbitrators could award, yet the award of the arbitrators was to be positively binding upon the country, without any recourse whatever, provided that the award were unanimous. This would have been dangerous legislation. There appeared to be no reason why a maximum limit should not be set, and *The Canadian Engineer* urged persistently that such a maximum limit should be placed in the agreement. Now that this has been done, the whole character of the legislation is materially improved, and if a reasonable maximum limit is placed upon the arbitration, the purchase of the railroad by the government will, we believe, meet with almost universal approval, especially if such a low maximum figure as $10,000,000 is satisfactory to the C.N.R. interests.

Whatever amount may be named in the agreement, the arbitrators may decide that Mackenzie & Mann have very little or no equity in the railroad, and to name a maximum limit does not mean that the arbitrators are going to award that amount. Moreover, it would not seem to be fair to Mackenzie & Mann to hinder the work of the arbitrators by placing what might prove to be a foolishly low limit upon the value of the Mackenzie & Mann equity. While the C.N.R. interests should not desire to cut any melon in this purchase, on the other hand, there is no reason why the government should acquire the railway over the bargain counter. Any equity that Mackenzie &

Mann or others may have, should be paid for without discount and without premium.

It is to be hoped that no coercion was used in getting Mackenzie & Mann to agree to the $10,000,000 limit, as any reasonable limit—even triple that amount—would have safeguarded the interests of the country under the conditions of the arbitration; and it is also to be hoped that Mackenzie & Mann will not be forced to accept $10,000,000, but will have further reference or recourse to parliament, if the evidence brought out by the arbitration really proves their equity in the C.N.R. to be worth more than $10,000,000 even after making all due allowances for the railroad's present financial condition.

PERSONALS

JOHN LAXTON, of Toronto, as a member of the Toronto Harbor Commission, has had his term extended for three years from October 22nd, 1917.

Lieut. HUGH K. WYMAN, B.A.Sc., 1911, of Toronto, has been awarded the Military Medal in recognition of his long and valuable services at the front.

Pte. C. M. CANIFF, M.Can.Soc.C.E., of Toronto, a graduate of the School of Practical Science, has returned home. He went overseas with the 74th Battalion.

W. A. BOSTWICK has been elected president of the International Nickel Co., New York City, to succeed Ambrose Monell, who resigned to enter the government service.

W. H. EDWARDS, architect, formerly of Hamilton, Ont., has been appointed school architect of the Board of Education, Denver, Col. Mr. Edwards is a native of Dundas, Ont.

J. J. SCOLLON, connected with the Toronto plant of Canadian Allis-Chalmers, Limited, has been appointed general superintendent of the company's re-opened branch at Bridgeburg, Ont.

Lieut. A. LESLIE, of Toronto, an employee of the traffic department of the Bell Telephone Company prior to enlistment, has been wounded. He is a graduate of the School of Practical Science.

Lieut.-Col. G. G. NASMITH, C.M.G., director of laboratories, Department of Health, Toronto, delivered an address at the opening of the new laboratories for the Department of Public Health at Buffalo.

C. H. BROMLEY, who for the past four years has been in charge of the water and public works department of Grimsby, Ont., has been elected a member of the Institute of Municipal Engineers of Great Britain.

D. C. MCKEON, who has been connected with the Canada Carriage Company, of Hamilton, Ont., for many years, has been appointed sales manager of the Menard Motor Truck Co., of Windsor, Ont., and will be located in Windsor.

PERCY C. BROOKS, vice-president and manager of the Canadian Fairbanks-Morse Co., Toronto, has been appointed president of the E. & T. Fairbanks Co., scale manufacturers, St. Johnsbury, Vt., in succession to Frank H. Brooks, who has resigned.

R. V. H. KEATING, of Port Arthur, Ont., has left for Windsor, Ont., where he will spend some time as resident engineer on the large contract which the Great Lakes Dredging Co., of Port Arthur, has obtained at Ojibway from the Canadian Steel Corporation.

DONALD G. MCGREGOR has been appointed in Manitoba under the grant of the Canadian Advisory Council on Research, to assist in special research which is being carried out in the department of chemistry, University of Manitoba. Mr. McGregor is a graduate of Dalhousie University, Nova Scotia, and in 1916 was chosen as the Rhodes scholar from that province.

Lieut. J. J. CAMPBELL, Junior Member of the Canadian Society of Civil Engineers, of Galt, Ont., a graduate of the School of Applied Science, 1914, has been wounded in action. He enlisted and went to Kingston for a course at the Provincial School of Instruction in February, 1916. Going overseas as gunner with a draft from the 67th (University) Battery, he was later promoted to bombardier, and afterwards gazetted a lieutenant.

Lieut. E. V. DEVERALL, Toronto, of the Royal Engineers, is reported to have been wounded. He was with the 204th Battalion at Camp Borden last summer, and later transferred to a University Training Company draft which went overseas about last Christmas. He completed his training in England, and has been in France since June 22nd last. He is a 1915 graduate of the School of Practical Science, University of Toronto, and a student member of the Canadian Society of Civil Engineers. Prior to enlistment he was with the Dominion Bridge Co. He is 27 years of age.

OBITUARIES

RICHARD TOPE, contractor, Hamilton, Ont., passed away at his home, 191 Robinson Street, aged 65 years. He was a native of Devonshire, England, and went to Hamilton about 39 years ago.

Capt. A. T. RICKARDS, of the R.G.A. and Royal Flying Corps, is reported to have been killed in action at the front on September 13th. Captain Rickards was a graduate in the Faculty of Applied Science at McGill University and on the outbreak of war proceeded overseas, receiving a commission at a later date with the R.G.A. He had been mentioned in despatches on several occasions while attached to the Royal Flying Corps, which he subsequently joined. He was the only son of Mr. F. T. Rickards, of 25 Corfton Road, Ealing, England, and was born in Bombay 25 years ago.

ROLLING PLATE IN HAMILTON

The Dominion Steel Foundry Co., Limited, of Hamilton, Ont., last month commenced rolling plate, and is producing up to twenty inches wide and three-quarter inch thick. The length is limited by the ingot, which at present weighs 500 lbs. While a width of twenty-two inches is the maximum which the company cares to handle with its present apparatus, it hopes soon to be able to increase this width.

COPIES WANTED

Copies of *The Canadian Engineer*, issue of September 20th, 1917 (Quebec Bridge issue) are wanted. Subscribers who do not bind their copies and who do not wish to keep that issue can have their subscription extended one month by mailing their copy to Circulation Manager, The Canadian Engineer, 62 Church Street, Toronto.

Barrett Specification Roofs

Made in Canada

Canadian Pacific Railway Hotel, Calgary, Alberta.
Architects: Edward & W. S. Maxwell, Montreal.
General Contractors: P. Lyall & Sons Construction Co., Ltd., Montreal.
Roofers: D. R. Foulds, Limited, Calgary.

How the 20-Year Guaranty Operates—

THE following illustrates the working of our new plan to guarantee Barrett Specification Roofs for twenty years:

When the question of roofing is reached in the specifications covering the building the following, or its equivalent, should be inserted in the building plans:

> "This roof shall be laid according to The Barrett Specification dated May 1, 1916, and the roofing contractor shall upon completion of the job deliver to us the Barrett 20-Year Guaranty Bond, in accordance with Note 1 of such Specification."

Competitive bids may then be asked for from a number of roofing contractors.

The concern to which the job is finally awarded promptly notifies us regarding the work, asks for our Inspection Service, and the 20-Year Bond.

Our inspectors supervise the job, see that the Specification is strictly followed both as to methods and materials, and on its completion certify that the roof is O.K. in every respect.

On this certification the guaranty company issues a 20-Year Surety Bond which *exempts the owner from any maintenance or repair expense to the roof until 1937.*

The Guaranty Bond costs the owner and the roofing contractor nothing.

The service is free in the interest of good workmanship and the good repute of our materials.

How to Get the 20-Year Guaranty Bond

This new Guaranty Bond is issued on all Barrett Specification Roofs of fifty squares or more in all towns of 25,000 population and over, *and in smaller centers where our Inspection service is available.*

Our only requirements are that the roofing contractors shall be approved by us and that The Barrett Specification dated May 1, 1916, shall be strictly followed.

If you are interested we should be very glad to send you further details or copy of The Barrett 20-Year Specification, with diagrams, ready for insertion in your building plans.

The Barrett Company LIMITED

MONTREAL ST. JOHN, N.B. TORONTO HALIFAX, N.S. WINNIPEG SYDNEY, N.S. VANCOUVER

Coast to Coast

Brantford, Ont.—An announcement has been made from New York that the American Steel Products Corporation has been organized with a capital of one million dollars, the officers being W. P. Kellett, president; D. O. Johnston, vice-president; treasurer, M. M. McGraw; secretary, P. H. Secord, all of Brantford. The new organization will take in the Dominion Steel Products Company, of this city, and it is expected that as a result the local company will double its present plant. The local plant is now working on the line and propeller shafting for one hundred of the new ships being built in the United States.

Brantford, Ont.—Brant County Council passed a resolution requesting the Lieutenant-Governor-in-Council to create a suburban road commission for the county. City Engineer T. Harry Jones favors that action and has written the City Council suggesting that that body take similar action.

Chatham, N.B.—It is rumored that Montreal parties are negotiating for the purchase of the Dominion pulp mill and lands. A mechanical man from Montreal recently inspected the plant with a prospect of it being enlarged.

Forest, Ont.—The Town Council has asked the Ontario Railway Board to have their by-law, asking for debentures for $1,500 for a fuel depot, approved.

Hamilton, Ont.—City Engineer E. R. Gray is preparing a statement showing the cost of maintaining water pipes under the railway tracks in various parts of the city and a report on the question of road maintenance between the main lines of tracks where they cross city streets. He takes the position that the city should not be put to the expense of repairing frequent breaks under the main lines and the switches over which heavy trains pass and jar the pipe joints, and recommends that the city place the matter before the railway board.

Hamilton, Ont.—The new combination pump and hose truck built by the Seagrave Co., of Columbus, Ohio, for the fire department, has arrived in the city, and the tests will be made in the near future.

Lethbridge, Alta.—It is expected that the work of installing the new filtration plant will be completed by February 1st. The system has a capacity of three million gallons of water per day, and the sedimentation basins have a capacity of 500,000 gallons at one time. The system is built so that it will be quite easy to double the capacity at any time necessary. The plant is being installed by the Roberts Filter Mfg. Co., and when completed will cost in the neighborhood of $106,000.

London, Ont.—Over $140,000 of building permits have been issued so far this month, exceeding by $30,000 the total for the whole of October, 1916, which was only $110,000.

London, Ont.—The C.P.R. will, by the time that winter stops further work, have completed improvements east and west of London that involve an expenditure of about half a million dollars. Sidings have been lengthened, bridges rebuilt, yards improved, and many other works undertaken. Many thousand dollars are being spent at Galt in rebuilding the bridge and enlarging the yards. New abutments are being put under the bridge at Ayr. At Chatham recently concrete work that was put up 40 years ago and which had been gradually settling into the river has been replaced. A new $35,000 station is being built at Windsor and about $20,000 is being spent in London on additions to the station and an addition to the blacksmith shop in East London.

Mimico, Ont.—By order of the Ontario Railway and Municipal Board, the County of York will pay slightly more than half of the cost of the bridge to be built at Mimico Creek by the Toronto-Hamilton Highway Commission. The estimated cost of the new bridge is $26,205, and the county's share is $15,420. The proportion to be paid by either party will be the same should the cost be greater or less than the estimate.

Montreal, Que.—The members of the City Council and the Board of Control adopted a resolution favoring a change in the present system of city government. All details of what the change will consist of were deferred till a later date.

Newcastle, N.B.—The International Shipbuilding Corporation has commenced the erection of an extensive plant for wooden vessels at Nordin, on the Miramichi River. The first keel will be laid in a short time.

New Westminster, B.C.—An order-in-council has been passed at Ottawa establishing a permanent harbor headline on the south shore of the Fraser River opposite New Westminster, beyond which no wharves may extend from Port Mann to the Government wing dam at Annieville Bar. This harbor line was determined on resolution of the New Westminster Board of Harbor Commissioners, recommended by the chief engineers of the Public Works and Marine Departments, and is concurred in by the Minister of Public Works and Marine. Plans and a description are on file at the office of Mr. C. C. Worsfold, resident engineer of the Public Works Department, Post Office Building, New Westminster.

Ottawa, Ont.—Notice is given of the incorporation of M. J. O'Brien, Ltd., Ottawa, with a capital stock of $20,000,000. The purpose of the company it to take over and carry on all the business enterprises as railway contractor, lumberman, mine owner, manufacturer, etc., heretofore carried on by M. J. O'Brien, of Renfrew. The provisional directors of the company are: M .J. O'Brien, J. L. Murray and H. A. Jordan, of Renfrew; J. A. O'Brien, Ottawa, and George A. Campbell, Montreal.

Peace River, B.C.—Work on the erection of a new elevator here has been started, and Contractor Worton, of Grande Prairie, expects to have it finished before December 1st.

Prince Rupert, B.C.—It is reported that car ferries for the handling of ore will be built at the drydock plant here.

Sarnia, Ont.—Contractor A. Dowsell is making rapid progress on the construction of the Lochiel Street sewer, and nearly half of the first block of excavation has been completed. With the sewer completed, the street will then be in shape for the construction of additional pavement, from the end of the present pavement at Victoria Street to College Avenue, as was proposed some time ago.

Sarnia, Ont.—Excavation work on the new 8-inch water main to the site of the Mueller Company's plant in Port Huron will commence shortly. Work on the foundations for the buildings is also being rapidly pushed along and the erection of the buildings will commence as soon as the tenders are awarded.

Smithers, B.C.—What is known as the Aldrich mining property near here, on which have been uncovered ore bodies carrying a large percentage of zinc, has been bonded to a mining company of Portland, Ore., and if the preliminary development work is satisfactory, the company will install a concentrator.

Three Rivers, Que.—Fred. J. Argall, 32 Des Forges St., plans to organize a shipbuilding company to construct wooden vessels.

Toronto, Ont.—The Dominion Board of Railway Commissioners decided that the C.P.R. should pay the city of Toronto $115,000 as part payment of its portion of the cost of the high level bridge over the Don River. On the same basis the city is to receive $135,000 from the C.N.R., $30,000 from the G.T.R., and $80,000 from the Toronto Railway Co.

Vancouver, B.C.—Meetings are being held at the Vancouver Chamber of Mines, October 29th to November 2nd, the object being to interest the general public in mining matters. Addresses are being given by a number of prominent speakers.

Vancouver, B.C.—The trial of the suit between the Seattle Construction and Drydock Co. and Grant Smith & Co. over the capsizing of a large floating drydock belonging to the plaintiffs during the construction of the Ogden Point piers by the Government at Victoria has opened in Supreme Court here. This case has been pending for over two years and is said to involve over half a million dollars.

Windsor, Ont.—A meeting of the Essex Border Utilities Commission was recently called by the chairman, Gordon M. McGregor, to deal with the applications to the Ontario Railway Board on the apportionment of the cost for the joint sewer scheme which is under way.

Winnipeg, Man.—Of the $50,000 allocated for local improvements, 1917-1918, over $29,000 still remains unspent.