SPECIAL WATERWORKS EDITION

Canadian Engineer

ESTABLISHED 1893 (WEEKLY) ESTABLISHED 1893

With which is incorporated "THE CANADIAN MACHINE SHOP."

Vol. 14. Toronto, Montreal, Winnipeg, Vancouver, July 5, 1907. No. 7

INDEX TO ADVERTISEMENTS.

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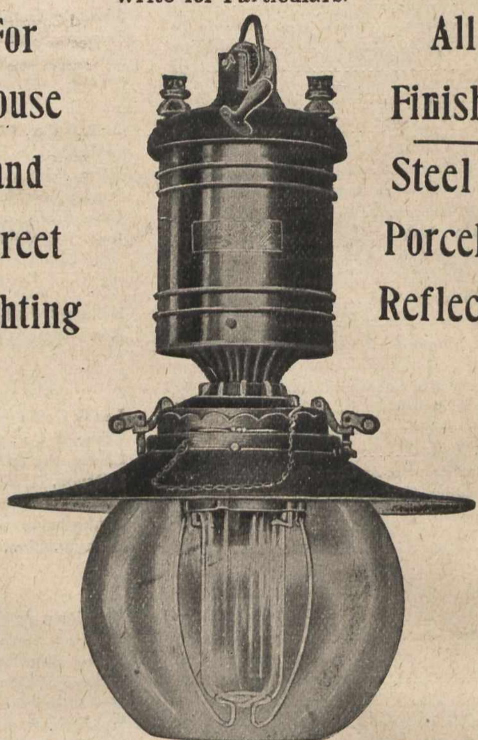
A site for a Government wharf is being located at Louisburg.

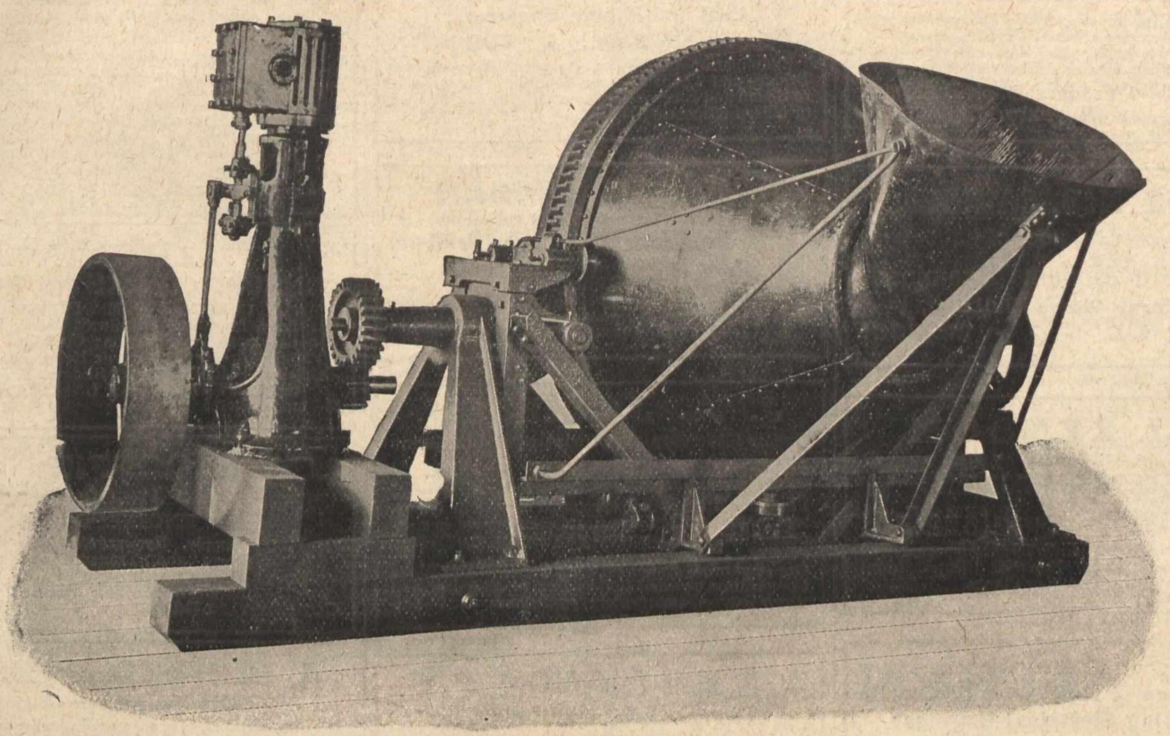
The contract has been let for the building of the Vancouver city wharf.

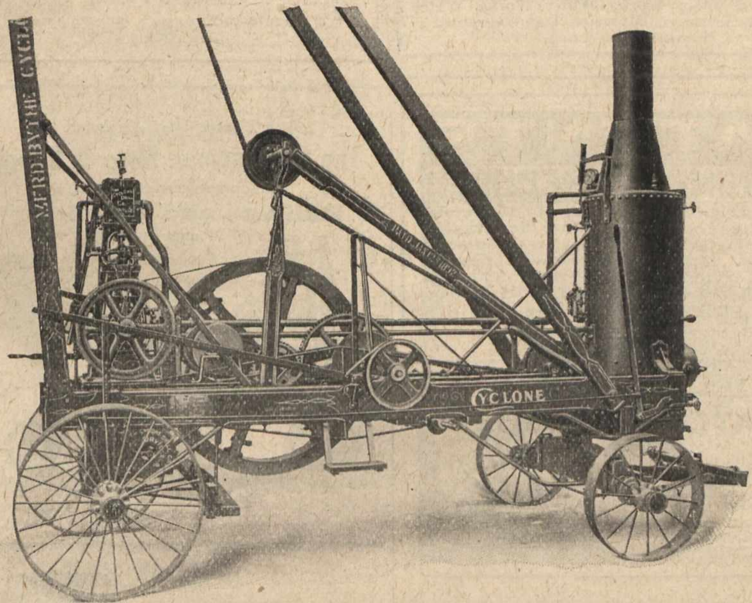
The Dominion Government has purchased the property of the Cunard Co. in Halifax, and will build modern warehouses and piers on the site.

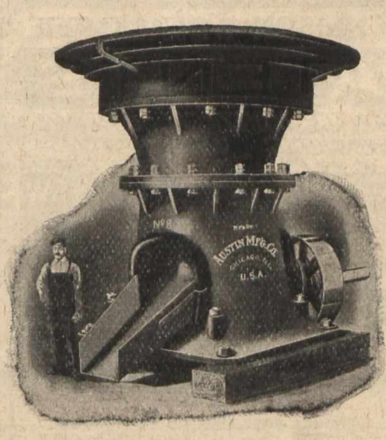
It is reported that the C.P.R. have placed a contract for a "Princess" steamer to run alternately with the "Princess Victoria."

Two new steamers are to be built at Esquimalt for the New England Fish Company, of Vancouver. They will be 150 feet long, and will cost about $80,000 each.









INTERNATIONAL COMMERCE.

The international commerce of the world now exceeds 26 billions of dollars, of which 13¾ billions are imports and 12½ billions exports. Of the imports of countries other than the United States, 14 1-3 per cent. are drawn from the United States, and of their exports, 9½ per cent. are sent to the United States. Mexico in 1905 took 65.99 per cent. of its imports from the United States; Canada, 50.59 per cent.; Nicaragua, 52.09 per cent.; Costa Rica, 51.65 per cent.; Cuba, 45.34 per cent.; Guatemala, 39.55 per cent.; Haiti, 35.56 per cent.; Colombia, 34.15 per cent.; Salvador, 31.18 per cent.; Venezuela, 30.22 per cent.; Ecuador, 28.86 per cent.; Japan, 21.35 per cent.; United Kingdom, 20.45 per cent.; Peru, 17.98 per cent.; the Philippines, 16.8 per cent.; China, 16.68 per cent.; Denmark, 16.08 per cent.; Argentina, 14.1 per cent.; Germany, 13.91 per cent.; Italy, 12.48 per cent.; the Commonwealth of Australia, 11.7 per cent.; New Zealand, 11.21 per cent.; Spain, 11.21 per cent.; France, 10.72 per cent.; Brazil, 10.33 per cent.; Chile, 9.92 per cent.; Uruguay, 9.67 per cent.; Russia, 9.66 per cent.; Austria-Hungary, 9.49 per cent.; Netherlands, 9.38 per cent.; Bolivia, 8.45 per cent.; Belgium, 7.98 per cent.; Sweden, 7.22 per cent.; Portugal, 7.13 per cent., and Korea, 6.19 per cent.

ENGINEERING SOCIETIES.

Canadian Society of Civil Engineers.—President, W. McLea Walbank, Montral; treasurer, H. Irwin; secretary, C. H. McLeod, room 877, Dorchester St., Montreal.

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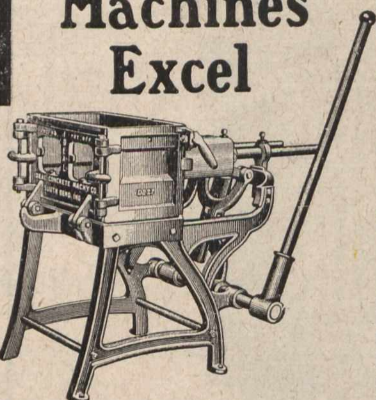

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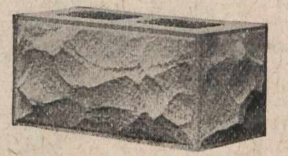

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THE EYE AND THE MIND.

"The effect of the practical school training upon an engineer is well shown in the following instance: The engineer referred to sent a drawing of an intricate forging to a firm in one of the Southern States. The manager sent it back, saying 'The piece cannot be made.' The engineer, thinking that the other had misunderstood the drawing, made a wooden model of the exact shape he wished the finished piece to have. This he carried over to the works in person. The manager said, 'Not only are we unable to make this piece, but the man does not live who can make it.' The engineer said, 'May I have the use of a forge?' This was granted, and all the expert blacksmiths of the place gathered around him to see this greenhorn of an amateur make a fool of himself. He worked through his task logically step by step, and brought out the finished piece just like the wooden model. He was then asked by the manager, 'Did you ever see one made?' 'No.' 'Did you ever see one like it?' 'No.' 'How did you know one could be made, and where were you taught to make it?' 'I was taught the principles on which everything is made at the Massachusetts Institute of Technology in Boston.' At this reply the manager said, 'I don't believe a word of it.'

"The above is a very good illustration of the different ways in which the two classes of minds look at things. The trained scientific mind is ready to undertake anything. The rule of thumb man will go as far as he sees, but his imagination fails him. The former can mentally analyze and reconstruct, while the latter can do only what he has been taught.

"The use of the shop for the development of skill and imagination is well illustrated in this way: The teacher of forging shows the pupil in successive lessons how to draw a piece of iron, how to make a piece round or square, how to punch an eye, how to make a weld, how to make an offset and a rivet. He then asks his pupil to make a pair of blacksmith's tongs. The answer comes: 'But I can't. I never did such a thing in my life.' The teacher is inexorable, and the pupil begins. He finds to his surprise that the task before him is simply a grouping together of a series of steps, each of which he has already mastered. The first tongs a good student makes will compare well with the work of an average country blacksmith who has had years of experience.—"Machinery."

The Canadian Engineer

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TORONTO, CANADA, JULY 5th, 1907.

ANNOUNCEMENT.

Owing to the agreement between the Postal Departments of Canada and the United States, by which the rates on second-class matter have been advanced from one cent to four cents per pound on all publications going into the United States, we are obliged to announce that the subscription rate on The Canadian Engineer, when going into the United States will be advanced to $2.50 per year. Current subscriptions will be carried at the old rate.

CONTENTS OF THIS ISSUE.

IMPRESSIONS OF THE CONVENTION.

The work that the members of the American Waterworks Association are engaged in is one that affects everybody. On the quality and quantity of water that can be supplied the lives and health of the population of the whole world depend. On this account everyone is anxious to know what these men are doing, as they are at least the purveyors of this precious liquid. People the world over require, and demand, pure water, and to meet this demand the Association which met in Toronto recently exists.

The Canadian Engineer appreciates the fact that water supplies throughout the Dominion are being developed rapidly, and in order to convey to those interested in developments along this line some idea of what is being done this number has been devoted entirely to waterworks matters, both in Canada and elsewhere.

It was pleasing to note the progress of this convention. Unlike the majority of conventions, nearly the whole of the session was given up to the business of the Association and the reading of papers of interest to everyone present. These men are all specialists in the purveyance of pure water to the consumer, and each one came prepared to tell the others his experiences of the past year.

Phenomenal enthusiasm was shown in the discussions, and it was evident that careful consideration had been given the subjects before the convention was called to order. As is usually the case where a number of authorities on any one subject are gathered together, opinions were widely different. This only made the discussions more interesting, and each delegate was enabled to take home with him a mass of information that it would be impossible to obtain in any other way.

Every session was well attended, and no lack of interest was shown, even on the last day. These vendors showed even more interest in their ware than the people who have to use it, and whose life depends largely upon the quality of the water they receive.

Very little recreation was arranged for, even the evenings being taken up with meetings at which papers were read and discussions took place. It has almost become proverbial that conventions of any sort are more of an "outing" than anything else. In the case of this Association, however, such was not so. "Business" was the watchword from beginning to end. This was as it should be. Unless an association can impart some benefit to its members it is of no practical value, and, looking from this standpoint, the "outing" convention is useless. "All work and no play" is not a good thing, but the main object should be work, the dissemination of knowledge.

The American Waterworks Association is to be congratulated on the manner in which its business is conducted, and it has in its secretary, Mr. J. M. Diven, a man who fills his position admirably.

The manufacturers' exhibition in connection with the convention was of the highest order, and the number that exhibited or had representatives in attendance was evidence that the meeting was one of great importance. A visit to the exhibition proved most interesting, as nearly all of the smaller appliances used in waterworks equipment were displayed, most of them being of the very latest type.

While in Toronto the visitors were treated as well as they possibly could be. There are, however, two things that might be pointed out as not being all that they might have been. In the first place, the large assembly room of the City Hall in which the meetings were held is more like the interior of a barn than the interior of the main room of a magnificent structure like Toronto's municipal building. Promises have been made from time to time that this room would be completed. As yet nothing has been done. Toronto should have an assembly room in the City Hall or elsewhere in which its visitors to conventions might hold their meetings without having to apologize for its condition on each occasion.

The second point to which attention may be drawn was the moonlight excursion on the lake on Wednesday evening. Instead of securing the finest boat of the port on which to entertain the delegates, one of the oldest was used. On this occasion it may have been impossible to charter any other boat, but where there is time to make arrangements in matters of this kind there should be no reason why the very best service could not be secured.

Conventions are one of the greatest advertising mediums that a city can have, and visitors coming in a body should be enabled to take home with them the very best impressions of the city that it is possible to give. No doubt everyone who attended the gathering went home pleased and well satisfied, but it is things of this nature that leave a canker, not upon the convention, but upon the city.

TO DISCOVER POLLUTION.

In a number devoted to the improvement of water supplies by mechanical means, most of which involve the conveyance of the liquid from a distance, it may seem a little incongruous to discuss an aspect of supply from old-fashioned wells. But most places in Canada will, for a long while, be dependent on more or less primitive sources for their water, and will be subject to the nervous hygienic conditions that are inseparable from them. Sometime ago it was fashionable to teach the average man that unless his well were very deep, or very far removed from possible contamination, he was in danger of nourishing all sorts of deadly bacteria, and was generally in the jeopardous position contemplated by the hymnologist, who said:—

"And fierce diseases wait around
To hurry mortals home."

There is not so much danger after all in a fairly shallow well, provided the subsoil be compact, and the surface be free from filth. Filtration through a very few feet of subsoil will purify water of even the most insidious germs. One of the ablest authorities upon questions of water supply is Dr. Thresh, Medical Officer of Health to the Essex (England) County Council, who, in a paper read to the Association of Water Engineers on "The Detection of Pollution in Underground Waters, and Methods of Tracing the Source Thereof," said some comforting things of typhoid fever propagation. He found that outbreaks of typhoid fever attributed to polluted waters have been in nearly all cases due to matter of excremental origin gaining direct access to the source of supply, or while the water was on its way to the consumer. Many cases have been reported where the disease has been attributed to the use of shallow well water; but in nearly every instance sewage practically ran into the well direct.

In numerous cases typhoid may be traced to the consumption of shellfish taken from polluted waters. These cases have been and are very often attributed to the water supply, principally owing to the fact that the drinking water, upon analysis, where the disease broke out showed some signs of contamination. This procedure naturally saves further investigation, but does not get at the real cause of the trouble.

Dr. Thresh has had a wide experience in dealing with outbreaks of typhoid fever, having made a special study of sporadic cases. Not a single case has come under his notice in which the well water could be considered the cause except where sewage had more or less direct access. The conclusion may be drawn that where water percolates slowly through several feet of compact soil it cannot carry with it the typhoid microbes. In water that takes days to pass through the subsoil into the well or spring the typhoid bacillus is either filtered out or loses its life.

Filtration and time are the two factors that make for the purification of water by the action of the soil. The more easily the polluting matter can reach the water, the greater the danger. But, though water that traverses a compact subsoil before reaching the well is as pure as it is necessary for water to be, there is considerable danger if the subsoil contains unfilled fissures, no matter what the depth of the well or the distance it may be from the source of pollution. When the water is bad, and there is no conclusive proof as to the source of pollution, experiments must be made at the most likely sources, so that when tests are made shortly afterwards it can be proved whether there is connection between the well and the supposed point of defilement by pouring water impregnated with some easily discernible but innocuous substance into the suspected ground.

Dr. Thresh has conducted many experiments to discover the best way of locating pollution. There are three main helps to discovery—common salt, a lithium salt, and a dye named fluorescein. In recent cases ammonium salts have been used. Common salt is used because it is inexpensive and easily obtainable, while it is a simple matter to estimate the quantity in the water. It requires one grain of salt to increase the chlorin in one gallon of water, and where only a small quantity of water is to be dealt with the salt is easily handled. But where large quantities of water are being dealt with another method must be used. One grain of lithium to fourteen gallons of water will provide an admirable test; but, as lithium costs about one dollar a pound, this method is somewhat expensive and very rarely employed. Ammonium chloride has been used with marked success, but in many polluted waters found in deep wells there is a varying quantity of ammonia, and in these cases definite conclusions might not be arrived at.

Fluorescein has proved very effective in discovering the source of pollution, and, excluding common salt, is the cheapest. It is the easiest to apply and detect, the only possible objection to it being that it may discolor the whole supply and alarm the consumer. But the disadvantage is trifling, compared with the efficacy of fluorescein, which seems unique among aniline dyes. While they become discolored by filtration through soils, nothing can affect the all-pervasive flourescein. Dissolved in water by the aid of an equal weight of caustic soda, it can easily be detected when the dilution is one in 100,000,000; and under favorable conditions one in 200,000,000 is discernible.

Out of 2,093 cases of typhoid which occurred in the county of Surrey only about 10 per cent. were caused by the drinking of impure water, which fact shows that typhoid bacillus are not carried to so great an extent as is generally believed. But nothing can alter the fact that the practice of many cities and towns of pouring the sewage directly into lakes and rivers from which the supply of drinking water is taken is most dangerous.

As indicated on the cover, this number is devoted exclusively to waterworks development. On this account all serial articles have been held over and will appear again in the issue of August 2nd.

MARKET CONDITIONS.

Toronto, July 3rd, 1907.

Admonitory words have been spoken by men in high financial and industrial position in the United States as to the probable effect of a "showing up" by railways in their undertakings and orders. And in some directions, where production has been excessive, such warning may be necessary, since United States manufacturers have repeatedly earned the character of being over-producers.

In Canada no check to the industrial activity is apparent unless it is that furnished by striking workmen here and there. The time chosen by some to lie idle is the busiest season of a busy year, when wages of all kinds are high and when willing men can earn night and day. It can only be assumed that the walking delegate has bewitched the men or bullied them into such folly. The Toronto machinists and boiler-makers, it is reported, are showing signs of weakening.

The employing plumbers of Toronto have stuck to one another with remarkable concord in resisting their striking workmen. And they have been able to fill the places of a large percentage of the strikers. Different employers announce the return of one, two, or three men each who have left the union and returned to work. Besides, there are numerous skilled workmen, secured in the Old Country, now on the way to Toronto, whose advent will give the plumbers' shops an activity which they have not witnessed for some months.

Pig iron is still firmly held; no No. 1 Summerlee procurable and No. 2 now brings $26. Canadian makers are all sold ahead and domestic iron is very hard to secure. Advices from the States say that prices are maintained because the furnaces are well sold ahead.

A letter of 20th June from Middlesbrough, the heart of the British iron district of Cleveland, says:—"There is nothing particular going on at the moment, except that the iron trade continues very brisk, and a large volume of business is being done. There is, however, some trouble with the engineers just now, and this may lead to a strike, which would be disastrous. Shipbuilding is not good here; there are no orders forthcoming." Glasgow advices of 21st say Cleveland iron market flat and irregular, closing 1-6 lower, the cause being weaker American advices. Stocks of pig in Connal's Scotch stores, 2,802 tons, as compared with 18,736 tons last June, and of Cleveland iron 284,000 tons, compared with 644,000 tons in June 1906. There is steady buying of Scotch pig by Germany.

Bar iron is very firm, and there is even talk of an advance, though it is easier to get deliveries now than it was. Wire nails are in request at same price as Montreal, $2.55 base. Cut nails are worth $2.75 here; spikes same as in Montreal, with a good demand. Wrought iron pipe is evidently going to be scarce this fall; makers are behind in their orders and cannot say when they will catch up. All who are in want of pipe better put in their orders at once. Even now there is talk of a rise in price.

We quote prices at Toronto as under:—

Antimony.—Continues to decline. Cookson's, $20.

American Bessemer Sheet Steel.—14 gauge, $2.70; 17, 18, and 20 gauge, $2.80; 22 and 24 gauge, $2.90; 26 gauge, $3; 28 gauge, $3.25.

Bar Iron.—$2.30, base, from stock to the wholesale dealer.

Boiler Heads.—25c. per 100 pound advance on boiler plate.

Boiler Plates.—¼-in. and heavier, $2.50.

Boiler Tubes.—Lap-welded steel, 2-in., $9.10; 2¼-in., $10.85; 2½-in., $12; 3-in., $13.50; 3½-in., $16.75; 4-in., $21 per 100 ft. Demand steady, prices unaltered.

Cement.—Star brand, $1.95 per barrel, f.o.b., Kingston. National, $1.95 per barrel, Toronto, in car lots; retail price, $2.15; English, Anchor brand, $3 per bbl. in wood.

Ingot Copper.—Fairly quiet. Toronto price: Lake, 26½c.; casting, $25.

Lead.—Active, and price still holds; $5.50 for pig.

Pig Iron.—Summerlee, No. 1, to arrive, nominally, $27; No. 2, $26; Cleveland, No. 1, $23.50, $24; Clarence, No. 3, $24.

Steel Rails.—80-lb., $35 to $38 per ton. Steel beams, channels and angles, 2¾ to 3c. per lb.

Sheet Steel.—Firm, 10 gauge, $2.70; 12 gauge, $2.80.

Tank Plate.—3-16.in., $2.65; Tees, $2.90 to $3 per 100 pounds; angles, 1¼ by 3-16 and larger, $2.75 to $3.

Tin.—Unchanged in price, 45c. for pig, very strong, and in fairly good demand.

Tool Steel.—Jowitt's special pink label, 10½c. per lb.; Capital, 12c.; Conqueror, highspeed, 65c. base.

Wrought Steam and Water Pipe.—Trade prices per 100 pounds are: Black, ¼ and ⅜-in., $2.31; ½-in., $2.81; ¾-in., $3.80, 1-in., $5.45; 1¼-in., $7.43; 1½-in., $8.81; 2-in., $11.88; 2½-in., $19.50; 3-in., $25.50. Galvanized, ¼ and ⅜-in., $3.14; ½-in., $3.66; ¾-in., $4.95; 1-in., $7.10; 1¼-in., $9.68; 1½-in., $11.61; 2-in., $15.48; 3½-in., blk., $32; 4-in., $36.25.

Zinc.—Sheet zinc firm, with a fair business doing. Toronto, slab $7; sheet, $8.

AMERICAN WATERWORKS CONSTRUCTION.

In a paper recently read in England before the Society of Engineers, Mr. E. R. Matthews, described a covered reservoir at Louiseville, which he stated was a good example of a modern American covered reservoir.

This reservoir is constructed throughout of reinforced concrete, including the division walls and piers. The roof is of groined arch construction.

The arches being approximately 19 ft. span and 3.8 ft. rise, the radius of the arc forming the intrados being 13.775 ft., and that of the extrados 32.256 ft. The thickness of concrete at the crown of arch is 6 inches, and above piers 3 ft. The reservoir is 460 ft. by 392 ft., and 394 ft. in size, and has a capacity of 25,000,000 gallons. The columns or piers are about 3.4 ft. diameter and 21.11 ft. in height, and are placed 22 ft. apart, centre to centre. The whole of this interesting construction has been carried out in Portland cement concrete 1:2:4. Embedded in each of the arches are 1½ by 5-16-inch concrete steel ribs, resting upon each pier. These ribs are inserted in eight half-piers; four of these being placed at the groins of the arch, and four midway. Two steel plates, 16 inches square by 5-16-inch thick, are placed in each pier; and in the side division walls of the reservoir, and the ribs meet upon and are riveted to these. The plates are placed 28¼ inches apart vertically, tied together in the middle by a ½-inch rivet. In order to make sure that the steel ribs adhered to the concrete, ⅜-inch rivets are placed through the middle of the rib about every 12 inches apart. The design was decided upon in 1898, and the work was completed in 1900. Both the arches and columns are stronger than necessary, were they only to support themselves and the earth filling. This has been proved by building upon the groined arches a concrete bed 8 inches thick over the crown, in which a track was built of standard steel rails, 80-lbs. to the yard, and loaded freight cars pushed over it with a combined dead and live load (car and freight) of 5 tons to the car-wheel, without visible effect upon arch or columns. When designing these arches it was not apprehended that it would be desirable or necessary to run cars across them. Great misgiving was manifested by contractors as to the practicability of building reliable columns of this description. The successful and satisfactory building of them proved to be one of the easiest and simplest tasks connected with the reservoir. The concrete was machine-mixed, but all the manual labor performed by crude and unskilled men, with whom difficulty was experienced in satisfactorily building the arches. It was accomplished only by constant and vigilant engineering supervision. With the experience gained in this work, entirely satisfactory results could be obtained, with reduction in both volume of concrete and cost of construction. The solidifying of the concrete by tamping was done by hand, in layers of about 4 inches in thickness at a time. Better results have since been accomplished by reducing the thickness of layers and using pneumatic tampers. The following is the area of water surface roofed over by the groined arches:—

	Sq. ft.	Sq. ft.
Total area of quadrangular space covered by the outside dimensions of the structure		180,740
Area covered by the four retaining walls...	18,541	
Area covered by the three division walls	4,460	
Area covered by the 256 columns supporting the groined arches	3,000	
Aggregate area of water surface in the four compartments	154,739	
Total		180,740

There are 340 groined arches, 270 of which are square, 22 x 22 ft. span between centres of columns and the remaining 70 run in one direction at 22 ft. spans, and at right angles thereto of variable span, under and over 22 ft. This is owing to the reservoir being of quadrangular plan, not a square, but a trapezoid.

The following table gives the items comprising the cost of constructing the arched covering of the clear water reservoir. In this table the material and work has been classified under ten subdivisions.

Classifications of Material and Work.

Per Sq. Ft.

1. 2,446.93 cub. yards Portland cement 1:2:4 concrete in columns at $7.10, $\frac{\$17,373.20}{154,739}$ $0.112
2. 333.32 sup. yards Portland cement, 1:2 mortar, in columns, at 29 cents, $\frac{\$96.66}{154,739}$ 0.001
3. 7,484.11 cubic yards Portland cement 1:2:4 concrete in arches, at $7.10, $\frac{\$53,137.18}{154,739}$ 0.343
4. 978.13 sup. yards Portland cement 1:2 mortar, in arches, at 42 cents, $\frac{\$410.81}{154,739}$ 0.003
5. 168,750 lb. steel ribs in concrete arches, at 3¼ cents, $\frac{\$5,484.40}{154,739}$ 0.035
6. 7,325.89 sup. yards neat Portland cement mortar ⅛-in. thick plaster on columns, at 23 cents, $\frac{\$1,684.95}{154,739}$ 0.011
7. 18,444.87 sup. yards neat Portland cement mortar ⅛-in. thick plaster on soffit of arches, at 23 cents, $\frac{\$4,241.40}{154,739}$ 0.027
8. 3,928.04 cubic yards earth fill over arches, at 30 cents, $\frac{\$1,178.41}{154,739}$ 0.008
9. 154,739 sup. ft. sodding, at 10½ cents, per superficial yard, $\frac{\$1,805.29}{154,739}$ 0.012
10. Centres for arches, and falseworks, $\frac{\$9,000.00}{154,739}$ 0.059

	$0.611
Less correction	0.001
Total cost per square foot of covering	$0.610

The mortar referred to in items 2 and 4, was used to interpose between successive additions of concrete, in order to make such additions adhere to one another.

A low buttress dam at Theresa was also described. This dam was designed by Messrs. Ambursen and Sayles, of Watertown, N.Y., and is 120 ft. long by 11 ft. high, and has a foundation on the solid rock. It consists of a concrete slope supported by concrete buttresses, the former being 6 inches and the latter 12 inches in thickness, the buttresses being placed 6 ft. apart centre to centre. The whole is reinforced by ¾-in. Thacher steel rods and expanded metal. The buttresses and toe are of Portland cement concrete, 9 to 1, and each buttress is bolted down to the rock by 1¼-in. bolts, 3 ft. in length.

WOODEN STAVE PIPE.

By Andrew Swickard, Assoc. M. Am. Soc. C.E.*

During an early period of the growth of some of our eastern cities, quite extensive water systems were installed, using small logs of trees with auger holes bored through them lengthwise, as distributing mains. The limitations of such a plant were many, and as soon as necessity required and circumstances permitted, pipes made of iron were used. The next stage in the use of wood in constructing water pipe is found in the New England States. Pipe of large diameter and made of wooden staves banded together by flat iron bands were used in a number of instances for carrying water from dams to water wheels. These were made up in sections 12 or 16 feet in length, and the sections were so tapered that the small end of one section entered into the large end of the adjoining section, forming a telescope joint. Pipe so constructed served the purpose very well. A few of these old New England pipes were still in operation up to a few years ago. In one case, at least, the pipe was in service nearly fifty years before being rebuilt.

The first wooden pipe built according to the present method, was installed by the Denver Union Water Co., at Denver, Colorado, about twenty-five years ago. According to the modern method, the diameter is uniform throughout, and the pipe is made continuous. The staves are milled so that the edges conform to radial lines and the sides to circles corresponding with the inside and outside radii of the pipe. Lengthwise across the end of each stave, slots are uniformly cut. When the ends of two staves are butted together, during construction, a metallic clip that fits tight in all directions is inserted in the slot. Bands of iron, or mild steel (round, not flat) are used to bind the staves together. The bands are spaced to withstand the pressure. The spacing may vary throughout the entire length of a pipe, from 10 to 12 inches to 1 or 1¾ inches center to center. The strain produced in the bands usually determines the spacing, but for a few sizes of pipe the bearing surface under the bands is the controlling element. For this reason it is not safe for one to undertake to design a wooden pipe unless he is familiar with all the factors that enter into the problem.

The great enemy of wood pipe is decay. If it could be controlled absolutely, the life of wooden pipe would depend entirely upon the life of the bands. In every locality there exist local conditions that will either hasten or retard the decay of wooden pipe. These local conditions cannot, as a general thing, be controlled in any way. When understood, they can sometimes be avoided when the pipe line is being located.

Decay is a vegetable growth and is communicable. A small amount of moisture, among other things, is necessary for decay to take place. Thoroughly dried wood, or wood constantly submerged in water will not decay. The moisture condition in the staves of a pipe carrying water never correspond with either of these two extremes, unless the pipe is laid below the surface of the ground water; the condition would then correspond to the latter extreme.

* "California Journal of Technology."

The degree of saturation of the staves of a pipe depends upon the pressure existing—as the pressure increases, the condition becomes less favorable for decay. The pressure can be varied at will by the designing engineer of a water system, and as a consequence, the moisture condition of the staves is the only element effecting decay that can be at all controlled. In all existing pipe lines, where decay has taken place, it began at the points where the pressure was the lowest. Even the lowest practical pressure will produce a moisture condition in the staves that is not the most favorable to the growth of decay. When decay takes place quickly and rapidly at the points where the pipe is near the hydraulic grade line, it is safe to conclude that the pipe is not running full at these points. When a pipe is installed for the purpose of supplying a town or city with water, a larger pipe than is necessary for the present needs of the community is usually built. If the quantity of water carried is regulated at the upper end, and is less than the maximum capacity of the pipe, the high points of the pipe, if the profile is irregular, will run only partly full of water. (By high points is meant the points on the profile that are near the hydraulic grade line.) Decay will take place quickly and rapidly at these points. The pipe line of the city of Astoria, Oregon, is an illustration of a case of this kind. The profile of the line is very irregular; approaching close to the hydraulic grade at a number of points. After about ten years of service it was necessary to rebuild short sections at these high points. It is a fact, without doubt, that the pipe did not run full at all times at these points. The staves were thus allowed to dry sufficiently to produce a moisture condition more favorable for decay growth than would have existed had the pipe been full. This same effect will be produced by the accumulation of air at the high points if means are not provided for allowing it to escape.

When a pipe is built in a locality where there is much decaying wood scattered on the surface of the ground, or where there is much vegetable matter in the soil, it is well to make the moisture condition of the staves more unfavorable to decay by keeping the pressure at all points, considerably above that due to a head of a few feet only. (Make the minimum, say 40 or 50 feet.)

Areas overgrown with willows or other trees or shrubbery that require much water should be avoided if possible in locating a wooden pipe line. Roots from such trees or shrubbery will entwine about the pipe in great masses and actually seem to kill the wood. Where conditions of this kind prevail, pipe will last but a comparatively short time. The selection of a wood of which a pipe is to be built is an important matter. It is necessary to have staves long and straight grained. On this coast there are but two kinds of trees that furnish lumber suitable for pipe construction. These are the Redwood of California and the Douglas Spruce or Fir of the North-West. It seems as though the choice between these two should be the one that resists decay the best, even though the lumber with the best resisting qualities costs the most. It has been claimed that if the staves of a pipe are always saturated they consequently will never decay. They are never thoroughly saturated. The degree of saturation depends upon the pressure, and the growth of decay is in inverse ratio to the degree of saturation. As a consequence, the staves are always more or less subject to decay, and it seems that it would be an act of wisdom to select the wood that resists decay best.

Wood pipe is, as a general thing, much cheaper and more economical than riveted steel pipe. Where the pipe is to be subjected to a comparatively high pressure (say 250 feet head or over) it might be cheaper to build of steel. There are so many variable elements due to locality that enter into the cost of pipe that it is difficult to make comparisons. As a general thing, wood pipe is from 30 to 50 per cent. cheaper than riveted steel.

The interior of a wooden pipe will not deteriorate as does that of an iron pipe. From the standpoint of steady capacity, the wood is far superior to iron. Not many careful experiments have been made on the flow in wooden pipe. Most of these that have been made can be found in the "Transactions of the Am. Soc. of C. E." The results are not materially better than those obtained by experiments on the flow in new smooth iron pipe.

The comparatively early deterioration of two or three existing pipe lines has been used as a premise for arriving at the conclusion that wooden pipe is a failure. Where there is one pipe line that has been a partial failure (there are no absolute failures) there are dozens that are giving the utmost satisfaction. Each partial failure has been due to local causes which might have been avoided if they had been understood. It is well known that iron pipe gives under some conditions the greatest satisfaction, while under others it is very unsatisfactory.

The use of wood pipe has been greatly extended in recent years. A number of long lines have been built in the East during the past two years. It is even attracting attention in Europe. The use of wooden pipe, on a larger scale, was decidedly a Western innovation. After a time demonstration of its worth it has found favor with the engineers of the East. At least in one case wood pipe has been favorably considered, by conservative English engineers. This is in connection with a large water project in India. Recently a number of inquiries have come from Japan for detailed information relative to design and cost, and even Siberia is getting into line. Up to the present time, installations have been made in America, from Alaska, to Peru, inclusive. Time has proven its worth, and under certain necessary limitations, a more extensive general use is assured.

COST OF PUMPING WITH THE AIR LIFT.

This question is usually asked without giving several items which largely determine the answer. Thus, coal at $2 is one thing, at $4 another. Again some wells are nearby, and in other plants the pipe investment is greater because of scattered wells. Speaking generally, the average cost per thousand gallons pumped depends on the size of plant and height of lift. In a 4,000,000-gal. plant, with a 50-feet lift, it is about ⅓c. per 1,000 gal. In a larger plant, with a 35-feet lift, with coal at $2, it is about 1½ mills. In another case, where the lift is 75 feet and the capacity 1⅓ million gal., the cost is 1c. per 1,000 gal., coal costing $2. In a plant pumping 3,000,000 gal. 75 feet high, the cost is 4.5c., and where the lift is 50 feet 3.5c. In Pennsylvania, a plant giving 175 gal. per minute at 75-feet lift, costs 1⅓c. per 1,000 gal. In a proposed municipal plant 100,000,000 gal. per 24 hours, 50-feet lift, and with coal at $1.50 a ton, the cost figured 1 mill per 1,000 gal., including all fixed and operating expenses. In another case, involving the handling of about 15,000,000 gal. of water 30 feet high every 24 hours, using compound condensing compressors, and with coal at $2 per ton, other figures being estimated on a very generous basis, the cost nets about $2.50 per 1,000,000 gal., or about 2½ mills per 1,000 gal. These figures cover fuel, oil, labor, sinking fund, interest and taxes.

In many cases the introduction of the air lift may be effected at little expense, often involving the purchase only of an air compressor, a receiver, and a small amount of pipe, but the following is estimated on a basis which will cover the greatest amount of expense likely to be incurred, with a view of showing particularly that the interest and depreciation charges under the most extreme conditions are not likely to develop into formidable figures. The following is a list of the complete equipment for an air lift plant to raise 1,500,000 gal. per 24 hours, or 1,250 gal. per minute. Total lift, 75 feet; Air compressor, complete, ready for foundation and piping. Air receiver. Boiler, 85 horse-power, with feed pumps, etc., bricked up and ready for use, including building and value of ground so occupied. Tank, 19,000 gal. capacity, including suitable timber framework to bring tank 75 feet above water level. Two 12-inch wells, each 135 feet deep, cased. Casing, 450 feet 7⅝ inch light pipe. Air pipe, 500 feet of 3-inch, air pipe in wells. Air pipe, 1,000 feet of 4-inch air line from receiver to wells. Water pipe, 1,250 feet of 12, 10, and 8-inch cast-iron distributing main, leaded joints, from tank to works, laid below frost (air line laid in same trench). All other pipe and fittings. Compressor, receiver and tank foundations, laid in cement. Special automatic governing mechanism. Total estimated cost of complete plant, ready to run, as above, $8,750. This is intended to include everything which may be considered as a legitimate expense in this connection. In many cases the buildings, boilers, tanks, wells, pipe lines, ground space, and other items do not represent a present expense, being already on the ground.

We may estimate the cost of operation as follows: Engineer, double shift, at $2.25 per day, $4.50, 1-5 time chargeable to pumping plant, per day, $0.90; Fireman, double shift, at $1.75 per day, $3.50, on the basis of one man required for each 250 horse-power of boiler for 85 horse-power per day, $1.19; fuel, 85 horse-power, 20 hours, say 4¼ tons, at $2 per ton, per day, $8.50; oil, waste, and sundries, say 60 cents; interest on investment of $8,750 at 5 per cent., figuring eleven 25-day months, or 275 working days per year, per day, $1.91; deterioration, covering sinking fund, repairs, etc., providing for renewal of complete plant every ten years same basis as interest but 10 per cent., per day, $3.18; insurance and taxes at 1 per cent., as above, per day, 32 cents; total estimate cost of pumping 1,500,000 gal. per day, 75 feet high, under the above conditions, $16.60. Cost of each 1,000 gal. ($16.60÷1,500) = $0.01107.—"The Engineering Record."

RECENT DEVELOPMENT AND FUTURE APPLICATION OF CENTRIFUGAL PUMPS.*

Comparison of Centrifugal and Reciprocating Pump Installations.

By D. S. Brown.

We find that the centrifugal pump presents a problem concerning which there is a scarcity of published information. Probably no other machine in general use has less tabulated data regarding it in general circulation, and its design and the uses to which it may be put are largely unknown to the ordinary engineer.

It may be wondered why a problem presenting so many interesting possibilities should have been so universally neglected. The reason, however, is doubtless due to the fact that the centrifugal pump, like the steam turbine was abandoned in favor of a reciprocating machine before it had been thoroughly developed because the principles of its action were not clearly understood.

Present Uses.

Most engineers are familiar with the big dredging pumps now in use for handling enormous quantities of sand and mud. No more economical form of handling can be conceived. From 25 to 40 per cent. sand is moved with ease, and continuously, and little power is used in proportion to the work accomplished.

In taking care of sewage also the centrifugal pump holds a firm place. The pump can be submerged in the sewage with shaft extending above to couple direct, or by gear, to an electric motor or steam engine. These pumps are generally designed to work automatically when electrically driven, the motor being started and stopped through the action of a float switch governed by a float in the pump-well.

For irrigation service, the centrifugal pump supplies a definite demand among farmers. Belted to a gasoline engine pumping into pipe lines distributed over the fields in which sprays are inserted, the centrifugal pump is a boon to the truck-farmer, allowing crops to be raised on otherwise unproductive land. On a larger scale, centrifugal pumps of enormous capacity have been used for irrigation, watering whole acres of desert land by methods which only the centrifugal pump has made possible.

The United States Reclamation Service is now making large use of centrifugal pumps for irrigation, in extremely large units as a rule, and they have been found to be the best outfits procurable.

The National Board of Underwriters, a most conservative body, has now under way the preparation of specifications for the use of centrifugal pumps for fire service in factories and mills. As an instance of the economy of space combined with high efficiency which the centrifugal pump possesses, we might mention the three-stage, 1,000-gallon pump now being built for the American Ship-Building Company to be installed on board a large lake boat for maintaining a fire pressure in its sprinkling system. This pump is to be driven by a 150-horse-power Kerr steam turbine, making a most compact outfit.

A newer application of centrifugal pumps is in connection with a vacuum-cleaning system for cleaning carpets, rugs, etc. Several of these outfits have been recently completed for a New York firm. The pump used is a 120-gallon machine direct-connected to an electric motor. A minimum space is secured by screwing the pump impeller on the motor shaft which is extended for the purpose. The pump draws water from a small tank and discharges through a nozzle into the same tank. One opening from the nozzle is attached to a cylindrical drum in which a vacuum of from 27.5 to 28-inches of mercury is produced. From this drum a hose leads to the sweepers and the dust taken from the carpets is collected in the drum. The entire outfit is so small and light that there is no doubt it will soon supersede the old-fashioned air-pump driven by a heavy gasoline engine, now a familiar sight on our streets.

I have recently designed and am now having built a Brooks pump for handling a saturated solution of chlorine which is at a temperature of 60 degrees C. This pump will be so built as to have every part coming in contact with the liquor covered with hard rubber. There is every indication that the experiment will prove a complete success, and if so, the easy, economical and satisfactory handling of all acids and acid liquors which attack iron or composition metals will be assured. A concern in Germany is also perfecting a pump built entirely of stone-ware for the same purpose, which they claim is proving successful. Our company also has underway the lining of Brooks pumps with porcelain enamel to serve the same purpose.

One of the latest innovations of the same company is a centrifugal pump lined with carborundum. This pump will prove invaluable for handling sand, gravel and similar gritty materials. Probably the first application of it will be in the Florida phosphate districts handling the phosphate rock, which is probably one of the most difficult substances known to pump, since it is almost as hard as a diamond.

And so the list could be continued almost endlessly. We find the centrifugal pump invading every line of industry, handling all sorts of unusual substances, which we hitherto-fore have been absolutely unable to pump.

Water Works Pumping.

There is, however, one phase of pumping work which up to the present time has seemed to have no place for the centrifugal pump, and where the high-duty, triple-expansion pumping-engine has reigned practically undisputed. I refer to municipal water-works where the pumps must create a given pressure in the city's mains to be increased in case of fire. I will endeavor to show that the centrifugal pump is already not only a serious rival but the absolute superior of the high-duty pumping-engine in this line of work. Let us take a case in point.

A certain city recently called for bids on a complete water-works plant to have a daily capacity of 20,000,000 gallons of water to be delivered to the city's mains at a normal pressure of 120 pounds, the same to be increased to 160 pounds in case of fire.

The Dayton Hydraulic Machinery Co. put in a bid on a centrifugal outfit driven by Wilkinson steam turbine. The

*Presented before the Ohio Society of Mechanical, Electrical and Steam Engineers.

chief competitor was the vertical triple-expansion reciprocating pumping-engine. This engine is of a style largely used in water-works, and we will, therefore, take up the arguments for and against centrifugal pumps using that engine as a comparison.

The main points of difference of the proposed installations are as follows:—

For the centrifugal pump plant, the first cost for 700 horse-power of Babcock and Wilcox boilers, boiler stack connections, feed water heater, two feed pumps with steam and hot water connections, pipe lines and asbestos covering, steam turbine driving a Brooks centrifugal pump, oil pumping and filtering system, excavation for foundation and concrete foundation for pumping unit, brick pump house with slate roof on steel trusses, exhaust line to condenser, condenser, vacuum pump and all necessary piping, suction mains with necessary valves and fittings, and discharge main with Venturi meter and recorder, $99,200.

For the reciprocating plant, the vertical, triple-expansion engine with exhaust line, condenser, vacuum pump and necessary piping, the connecting of suction main to condenser and pump, and the discharge main to the pump would cost $156,000. The cost of auxiliaries to be furnished by the city would be $28,500, making a total cost of $184,500.

Guaranteed duty for the centrifugal unit was 95,000,000 foot pounds per 1,000 pounds of steam, while the guaranty for the reciprocating unit corrected for 10 per cent. slip was 153,000,000 foot pounds. Delivery was 8 months for the centrifugal pump and 18 months for the reciprocating. The cost of pumping water for the first five years was figured out as $236,660.16 for the centrifugal unit and $247,966.40 for the reciprocating unit.

Comparing the construction and operation, the centrifugal pump has large clearances, rotary motion with no vibration, no thrust at any part and easy accessibility by removing the top off the turbine and pump. All parts are lubricated by forcefeed oilers, the pressure can be instantly varied by varying the speed of the unit, the pump delivers exactly the amount of water required, acting automatically without controlling devices, produces no water hammer and no excess pressure. The reciprocating unit has necessarily close contacts and small clearances, with more or less vibration on account of the reciprocating motion, and heavy thrust on the reciprocating parts, and is somewhat inaccessible on account of complication. Most of the bearings are oiled by small hand-feed cups, variation in water pressure must be secured by throttling, with the engineer stationed at the throttle, and a variable delivery must be secured by means of an automatic controlling device. The reciprocating motion is likely to produce water hammer, pressure varying with the demand for water in the system.

Saving in attendants will be two oilers, in favor of the centrifugal unit. There will also be some saving in oil and waste on account of the reduced number of bearings and parts to be kept clean. It will be noted that the bid on the centrifugal plant includes everything needed, while the reciprocating estimate is on condenser and engine only. The acceptance test for the centrifugal installation was to be for 300 hours, based on actual foot pounds of service as shown by the Venturi meter, while the acceptance test for the reciprocating engine was to be 24 hours and based on the record of revolution counters with slippage estimated. Rather more favorable terms were also given in regard to payment by the makers of the centrifugal unit.

The pump which we propose to use is a double, three-stage, 12-inch unit, each half of which delivers 7,000 gallons a minute. The turbine is a Wilkinson steam turbine built in Providence, R.I., which will deliver 1,615 horse-power at 800 revolutions a minute, whose speed can be changed instantly by the simple act of shifting the lever of the governor without stopping the apparatus to a maximum of 1,020 revolutions per minute at which speed it delivered 2,150 horse-power. This change in speed creates a change of pressure from 120 pounds to 160 pounds for fire service at the pump. The enormous advantage of just this one point over the other system will be readily recognized. We find from reputable authorities that from 8 to 10 minutes are consumed by the reciprocating pump in bringing up the pressure from normal to that for fire service. When a fire is gaining headway every minute, this advantage is of vast importance. The saving in maintenance cost is from $2,000 to $4,000 a year.

In view of all these facts, therefore, we can safely predict that within the next few years the turbine-driven centrifugal pump will replace the present line of plunger pump for municipal water-works, hydraulic elevator service, fire pumps, and, in fact, nearly every service where the volume of water is large enough to obtain the high efficiency of the centrifugal pump.

AN IMMENSE IRRIGATION PROJECT.

The waters of the Rio Grande River are to be used in irrigating a large area of arid soil in Mexico. The total cost of the work to be done is estimated at $7,200,000. The reservoir, says the "Calgary Herald," will be the largest artificial lake in the world, the Assuan Lake in the Nile taking second place. It will be behind a dam set in a narrow gorge of the stream 120 miles above El Paso and nine miles west of Engle, a station on the Atchison, Topeka and Santa Fe; hence the name Engle.

The dam, which will be of cement and rubble concrete, will be set between bluffs of solid rock. Its base will rest on solid rock 65 feet below the bed of the river, and it will stand 190 feet above low water.

At bedrock the dam will be 250 feet long; at river bed 400 feet, and at the crest 1,150 feet. At the bottom the dam will be 180 feet thick and at the top 20 feet. The spillways will be 15 feet below the crest of the dam, making a reservoir 175 feet deep at the lower end.

The lake will be forty-five miles long, and the width of the valley. It will cover an area of 38,400 acres, and it will have a storage capacity of 2,000,000 acre feet. It is proposed to capture and hold in this reservoir until it is needed for use all water supplied by rain and snow in the basin of the river and its tributaries above the dam in New Mexico and Colorado.

The capacity of the reservoir means water enough to cover 2,000,000 acres of land a foot deep. If it were possible to put it all in a square tank with a surface area of one acre the tank would have to be 379 miles high to hold it.

The lands of the valley below the dam will require about 600,000 acre feet a year, leaving, if the reservoir once be full, 1,400,000 acre feet, less loss by evaporation, for dry seasons. The mean annual flow of the river is 800,000 acre feet. In the flow nearly 2 per cent. is silt, which will be captured by the dam, drawn out by under-sluicing to enrich the fields.

Protect Present Users.

From the bottom of the reservoir it is proposed to draw and turn into the river again water, in uniform flow, sufficient for the needs of the lands below. The estimated needs of the valley are 600,000 acre feet a year. This is for 200,000 acres, but for the present only 180,000 acres is taken into consideration by the engineers. Of this area 110,000 acres lies in New Mexico, 47,000 in Texas and 23,000 in Mexico.

By the reclamation act no person may have water for more than 160 acres, but he must pay the annual instalments for all the land he may own. This means that a person who may own more than 160 acres will have to sell the excess or let it lie idle. The lands lie in little areas where the valley widens. At the head of these areas diversion dams will be constructed and water sufficient for the irrigation of the lands below turned into the mother ditch. The first of these areas below the Engle dam is Las Palomas valley, the next is Rincon valley, the next is Mesilla valley and finally El Paso valley, which runs into Texas and Mexico.

The Pueblo Indians were the first to cultivate the fields of this district, using very crude methods of irrigation. There are now to be found in the district many old canals made by the Spaniards. The canal which distributes water at Juarez and below, on the Mexican side of the stream, has been flowing for more than 300 years. Into this canal the 60,000 acre feet allotted to Mexico from Engle dam will be turned.

Already the Reclamation Service has begun work on the project, but for the present only a diversion dam and ditches under it for the irrigation of the Mesilla valley, a subdivision of the larger valley, will be constructed, and the rest of the work will be left until the engineers complete their plans. This part of the project will cost $200,000 and will water 70,000 acres, so that the diversion dam is no small enterprise of itself.

The dam proper is about completed, and already water has been turned into ditches that have been in operation under the community system for many years.

WINNIPEG'S FIRE PROTECTION.

According to the report made by H. M. Ruttan, city engineer of Winnipeg, the pumping plant has a capacity of 10,600,000 gallons daily for fire protection. The following table shows the water and pumping capacity available:—

Wells Only in Service.

Wells.	Capacity of Pumps, 24 hours.	Water Available, 24 hours.
No. 2	10,000,000 at 125 lbs.	3,100,000
No. 3	2,500,000 at 125 lbs.	700,000
No 4	2,500,000 at 125 lbs.	1,000,000
		4,800,000

Wells and Reservoir in Service.

	Gallons.
Reservoir, new	5,500,000
Reservoir, old and softening plant	300,000
Wells as above	4,800,000
	10,600,000

Taking into consideration the usual average consumption, with a full reservoir, the city could furnish 5,500,000 gallons in three hours, for fire protection alone, 4,000 gallons a minute, equal to 20 hose streams of 200 imperial gallons each for twenty hours.

Concerning the amount of water used in fighting fires, the following information may be of interest, if only as a matter of record. The information is taken from the testimony of F. P. Stearns, chief engineer of the Metropolitan Waterworks, before the auditors in the suit for the taking of Spot pond. The information was compiled from the Venturi meter chart records for the 48-inch Venturi meters on the Boston low service mains. Mr. Stearns said:—

"The diagram for November 12th, 1904, happened to show the existence of one of the largest fires that have occured in Boston since these meters have been in use (Harcomb building). The number of engines in use at the fire was 21; length of time for each engine, from 1 hour and 15 minutes to 17 hours and 20 minutes. The results from the autographic records indicated that there was an excess of flow from 12 p.m. to 6 a.m. November 12th. The maximum rate of flow during this period above the usual flow was 15,000,000 gallons; the rate lasted for thirty minutes. The total quantity of water used in excess of the ordinary amount was 2,150,000 gallons."

Kenneth Allan writes from Atlantic City as follows concerning a large conflagration which occurred there on April 3rd, 1902: —

"The fire started at 10 a.m., and was under control by 3.15 p.m. Including three steamers from Philadelphia and two from Camden, there were sixteen, furnishing twenty-three streams, making, with those from hydrants, about thirty streams in use during the height of the conflagration. The total pumpage from noon, April 14th, was 9,318,290 gallons (nearly all of this was measured by a Venturi meter), which was about 2,875,119 gallons above that pumped during the twenty-four hours preceding and the twenty-four hours succeeding the period; 2,900,000 gallons may therefore be taken as the approximate volume of water consumed in putting out the fire."

Water used in Winnipeg at different periods is given as follows:—

Date.	Duration of fire.	Gals of water used above average.	Res. well reduced.
1906.			
December 19	2h. 11m.	none.	not red.
1907.			
January 28	10h. 50m.	1,000,000	2.49 ft.
February 4	1h. 5m.	40,000	0.10 ft.
April 6	3h. 3m.	560,000	1.40 ft.

STREET RAILWAY INTERSECTIONS.

An entirely novel form of street railway intersections, the first to be tried not only on this continent but abroad so far as is known, is to be thoroughly tested by the Toronto Street Railway Company.

Since it is only an experiment, it will be some time before the company will be able to report fully upon the work. Two special forms of this new construction will be given a thorough test, and the form which stands the tests and proves most serviceable and efficient will in all probability be eventually adopted by the company for all their intersections.

The first class of intersection is that just completed at the corner of Yonge and King Streets. Here the crosses, switch pieces, etc., are all made of solid cast manganese steel from the Hadfield Steel Foundry, Sheffield, England. The other class of intersection to be tried consists of built up pieces of rail sections, set in castings in order to be held secure, and with renewable manganese centres; these being supplied by the Lorain Steel Works, of Johnstown, Pa.

The cost of construction in each case is about the same, while each form possesses advantages particular to itself, making it hard to predict the eventual outcome of the two tests. Owing to the working loose of the renewable centres, a decided point is gained by the solid cast manganese steel construction. These large manganese steel castings are, however, exceedingly difficult to make uniform, and in case of a defective piece being placed in the work, its removal would necessitate the tearing up of the steel, which would cause the stopping of traffic, thereby involving heavy expense both to traffic itself, and on account of the wasted material in the parts thrown out. Another point in favor of the built-up work lies in the fact that shrinkage in the solid manganese steel must be taken into consideration, and, therefore, it will be more difficult to get as perfect sections, with as perfect curves, as with the built-up form of construction.

To find the pressure in pounds per square inch of a column of water, multiply the height of the column in feet by .434.

The papers entitled "Special Fire Protection Service," by A. H. Wehr; and "Note as to the Action of Water Upon Lead and Zinc," found elsewhere in this issue, were read before the convention herein reported.

The steamer "Northwestern," of the Northwestern Steamship Co., which ran aground at La Touche, Alaska, some weeks ago, is to be repaired by the British Columbia Marine Railway Co., of Esquimalt, and will be again put in service.

AMERICAN WATERWORKS ASSOCIATION.

Twenty-seventh Annual Convention, Toronto, June 17th to 22nd.

The twenty-seventh annual convention of the American Waterworks Association, held in Toronto from Monday, June 17th, to 22nd, was pronounced one of the most successful and profitable meetings the Association has yet held. The bringing of this convention to Toronto was largely due to the efforts of Mr. Alexander Milne, superintendent of the waterworks at St. Catharines, and Mr. C. F. Fellowes, superintendent of waterworks, Toronto.

This was the first time the Association met in Canada, and the home committee is to be congratulated on having secured for the "Convention City" so great a gathering of men interested in such an important subject. At last year's convention, in Boston, Mr. Milne said that if the Association would hold its next meeting on Canadian soil the number of members in Canada would be greatly increased. This promise has been fulfilled, quite a number of Canadians who are interested in waterworks development having become members of the Association.

The attendance at Boston was somewhat greater than this year's, but the Boston numbers included the New England's

Geo. H. Felix, President.

Waterworks Association Convention. Considering this fact, the attendance at Toronto was even greater than that of Boston, and the excellent way in which the meetings were conducted throughout made it one of the most successful gatherings.

Upwards of 550 delegates and guests were present, the number including city engineers, waterworks superintendents, commissioners, consulting engineers, sanitary chemists, hydraulic experts, supply men, etc., from all parts of the United States and Canada.

Opening Day.

The opening day, Monday, June 17th, was taken up with the registering of members and guests at the secretary's office in the King Edward Hotel, the headquarters of the Association while in Toronto. Meetings of the Executive and Publication Committees were held during the day. The evening was given up to an informal reception, at which the delegates were made acquainted with one another as far as possible.

When registering, each person was given a souvenir badge containing the number opposite which his name appeared in the register, and, as this register was printed, the identification of each visitor was made possible.

Tuesday's Session.

The convention was formally opened on Tuesday morning in the large unfinished assembly room on the fourth floor of Toronto's magnificent municipal building. This room was beautifully decorated with Canadian and American flags and bunting, and over the platform, which bore the mystic number "71," were the portraits of King Edward VII. and President Theodore Roosevelt.

The initial attendance was about 250, many ladies being present. Rev. C. J. James, of the Church of the Redeemer, opened the convention with prayer. Mayor Coatsworth welcomed the delegates on behalf of the city of Toronto, making a brief apology for the unfinished condition of the assembly room in which the session was being held. He spoke of Toronto's admirable situation from the standpoint of its water supply; of the grave dangers always associated with contaminated water, and the difficulties experienced in keeping sewage and drinking water apart. He said the water supply was almost continually a source of anxiety and care. Most cities draw their water from places which are more or less in danger of contamination. He thought that the general opinion was that the drinking water should be kept as far as possible from the source of contamination. Toronto, notwithstanding that it emptied its sewage into the Bay, had a comparatively pure supply of drinking water. The city was very glad to welcome its American visitors.

Replying to the Mayor, President Dabney H. Maury, of Peoria, Ill., referred eloquently to the British and American flags with which the room was decorated. While the British Constitution was different from the American, the liberty under the former was just as great. He said that it was evident that the city had good government. "While your conservatism has been a wise one, it has not gone hand-in-hand with narrowness and prejudice." President Maury said that Toronto was situated about the centre of a circle having a radius of about 250 miles, within which was to be found the best supply of fresh water on the continent.

Instead of delivering the usual presidential address, President Maury read a paper, entitled "Rates of Water Service." "Before the rates could be termed fair these two conditions must obtain: First, the total yearly receipts from all sources must be just sufficient to provide a reasonable interest on the investment, annual contribution to the sinking fund to retire investment within a reasonable time, proper annual contribution to sinking fund for depreciation, legitimate operating expenses, including repairs; second; each consumer must pay yearly for the particular class of service that he receives his just proportion of the above annual costs. To fulfill the second condition no service whatever should be furnished free."

In dealing with the cost of fire protection he said that an average of available estimates made by eminent authorities shows that the annual cost of furnishing fire protection, under average conditions, is about fifty per cent. of the fixed charges and twenty per cent. of the operating expenses, the balance of fifty per cent. of the fixed charges and eighty per cent. of the operating expenses being supplied by the rates for the water. He divided fire protection into two classes—public and private. Neither class of protection, he thought, should be furnished free. "There are abundant reasons why rates should be paid for private fire protection. The owner of the factory or other establishment protected receives not only a yearly cash benefit measured by the reduction of his insurance premiums, but also a further substantial benefit in the power of protection against loss of business or other fire loss not covered by insurance. This latter benefit, while not so easy to measure in dollars and cents, is often of greater value than the actual reduction in premiums.

"The objection to fixture rates as a basis of value does not lie in the fact that they cannot be made in the aggregate for any city as a whole as equitable as any other rates; for this is not only possible, but is a condition which actually obtains within reasonable limits in many cities.

"In almost every city the introduction of meters, if accompanied by the establishment of the proper rates, can be made to result in benefit to the water department as well

J. M. Diven, Secretary,

as to the consumer; and it is possible with meters to make a closer approximation to the fair amount to be paid by each individual consumer than can be made without them."

The cost of the introduction of meters and of their subsequent maintenance should, with proper rates, soon be covered without the consumer having to pay any extra charge, as there would be a great saving in pumping expenses, and no extensions to plant would be called for, that otherwise have to be made.

Secretary's Report.

Your Executive Committee beg leave to report that they have examined all of the applications filed for membership in this Association since the last annual meeting amounting to one hundred and four individual active, nine corporate active and sixteen associate, and recommend the election of said applicants in their respective classes. We have examined the report of the secretary-treasurer, and approve the same. Your committee has further fixed the salary of the secretary-treasurer at the same amount as the preceding year. Your committee has received a number of invitations for this Association to hold its next convention in the various cities therein named, and herewith submit the same for your action. Your committee have voted to discontinue our membership in the National Fire Protection Association at the expiration of the present fiscal year, next November. Your committee also have to report with deep regret the decease during the past year of the following members. Two of them were past presidents of the Association: Col. John Foster, Jos. A. Bond, Samuel L. Morrison.

Following the reading of his report the secretary announced that the non-arrival of his trunk had made it impossible for the Publication, Finance and Executive Committees to present their reports.

President Maury, on behalf of the Committee on Electrolysis, reported that there had been no change in the legal situation during the year. The damage done to pipes by electrolysis continued.

The convention adopted the report and reappointed the committee to carry on the work.

The holding up of the trunk by the customs officials caused further delay, since it contained copies of the trade journal, "Fire and Water," which were to be used in lieu of reports of last year's convention.

A letter of welcome from the Engineers' Club, of Toronto, was received, together with a cablegram from Mr. N. P. Simon, of Moscow, Russia, conveying his best wishes for the success of the convention.

Afternoon Session.

The afternoon session was taken up with the reading of interesting papers. The first paper, by Mr. William Volhardt, of Stapleton, N.Y., on "Meters and Meter Systems," urged strongly the necessity of meters, and he advised the obtaining of an experienced engineer in installing a meter system. He favored metering an entire city or town at one undertaking, in which case the meter system would be regarded as the "square deal." Meters should be read every month, though the bills need not be rendered monthly. Meters and flush tanks would prevent the accumulation of solids in sewers.

This was followed by a paper on "The Cost of Meters in Rochester," by Mr. Geo. W. Rafter, consulting engineer, of Rochester, N.Y. This paper was criticized by City Engineer E. A. Fisher and Superintendent of Waterworks B. C. Little, of Rochester. The officials in question objected to Mr. Rafter's discouraging words about meters. Mr. Little said he was Superintendent of Waterworks at Rochester for sixteen years, and the setting of meters in that city had proved extremely satisfactory. Mr. Rafter, in his paper, stated that the use of meters in Rochester had not reduced the quantity of water used, but had actually increased it. One difficulty about meters was the disposition of cities to use a large variety of meters.

"Water Consumption, Waste and Meter Rates," by City Engineer J. L. Tighe, of Holyoke, Mass., was the subject of the next paper. The author said that the introduction of water meters resulted in reducing the per capita consumption of water from between 150 and 160 gallons per day to 116 gallons, and later to 114 gallons per day, notwithstanding that the legitimate use of water had naturally

D. H. Maury, Retiring President.

increased. He claimed that the consumption and waste of water could be controlled by meter better than by inspection.

In a discussion which followed it was evidently the opinion of the majority that the waste of water was not profitable under any circumstances. Mr. W. E. Sanders, London, an associate member, suggested that it would scarcely pay to spend $150,000 to save $100,000 worth of water.

Following this, a paper was read by J. S. Rosamond, of Fort Smith, Ark., on "Some Notes on Rules, Ordinances and Court Rulings Covering the Operation of Waterworks Plants." Secretary J. M. Diven, Charleston, S.C., read a paper on "The Care of a Mechanical Filter Plant," in which he emphasized the importance of having intelligent, experienced men in charge of filters. No general rule could be laid down for the care of filters, each case having to be considered by itself.

Evening Session.

Three papers were read in the evening, two of which were illustrated by lantern slides. The papers were as follows: "The Detection of Waterworks Losses," by Mr. Edward S. Cole, New York, and "Gas Producer Pumping Plant at St. Stephen's, N.B.", by Mr. F. A. Barbour, Boston. The former paper dealt with the pitometer, which detected waste. The useless waste and loss of water had been placed in a recent report as to Chicago at 76 per cent. of the total pumpage, and in other cities there was an enormous waste.

Captain H. G. Tarr, of Philadelphia, read a paper on "Greater Economy in Small Pumping Stations." He pointed out the wastefulness of the average steam pump, and advocated the use of the gas engine.

Wednesday's Session.

On Wednesday morning the reading of papers was resumed, and one of the most interesting discussions of the whole convention took place, the subject being "The Relative Merits of Steam and Electric Pumping." In this connection the experience of the city of Montreal was of value to the delegates, and Mr. John McDougall, Caledonian Iron Works Co., Limited, distributed among them a bulletin giving the official test of their three-stage, 14-inch Worthington pump, driven by a 400 horse-power Allis-Chalmers-Bullock, Limited, motor at the McTavish Street station.

"Electrically-driven Turbine Pumps" was the subject of this discussion. The paper of Mr. Henry L. Lyon, Deputy Water Commissioner of Buffalo, contended that the cost per million gallons of water pumped by electrically-driven engines was $4.84, while the steam-driven pumps required $5.22 per million gallons.

The steam end was upheld by Messrs. Will J. Sando, consulting engineer, Milwaukee; Charles O. Hague, consulting engineer, New York, and D. W. French, superintendent Weehawken, N.J., who claimed that the proximity of Buffalo to the Falls, and the consequent cheapness of electrical power there, weakened the argument in favor of the electrical pumps. In Boston, where coal costs $3.87 a ton, as against $2.50 in Buffalo, equalizing the head pumped against, the price of pumping was only $4 as against $5.22 in Buffalo. Seven municipal and fifteen individual pumping stations in the United States pump water cheaper than Buffalo, notwithstanding the favorable conditions existing at Buffalo.

This discussion was followed by a paper on "High or Low-duty Pumping Engines," by J. H. Reynolds, of Youngstown, Ohio. The speaker considered that each had, since the standardization of types, a field of its own, though each occasionally overlapped the other field. The low-duty machine could hardly be considered for pumps of over 5,000,000 gallons capacity, but up to that figure choice must often be made between the types. For handling small quantities of water, where the item of fuel was of secondary consideration, he considered that the duplex pump, on account of its lower first cost, had the field, it being very simple, and leaving little to be desired as a machine for handling water at moderate speeds.

Dr. W. P. Mason, of Troy, spoke about a peculiar instance of the contamination of well water. He told of a well of the Anti-Tuberculosis Association, of Wellingford, Conn., drilled through red standstone to the depth of 69 feet; this was contaminated, and had to be abandoned, through a gasoline tank under ground 130 feet away. "That was three years ago, and the well still tastes. If you get ground water contaminated with a mineral substance such as petroleum, you cannot hope for speedy relief, and you might as well abandon the source of supply."

The Executive Committee recommended the Association discontinue its membership in the National Fire Protective Association in November. The report was adopted. The Finance Committee reported in favor of raising the annual fee from $3 to $5. This will be considered at another session.

The interesting features of Wednesday morning's session were election of officers and the choosing of the next place of meeting. The election was a very quiet affair, but considerable enthusiasm was stirred up over the selection of the next convention city. Personal bids were made on behalf of Washington, Chicago, Milwaukee, Philadelphia, and Atlantic City, and invitations were also received from Ashbury Park, Detroit and Seattle. The convention made the choice of Washington unanimous.

The following officers were elected: Mr. George H. Felix, Reading, Pa., president; Mr. D. W. French, Hoboken, N.J., first vice-president; Dr. Wm. P. Mason, Troy, N.Y., second vice-president; Mr. Jerry O'Shaughnessy, Columbus, Ohio, third vice-president; Mr. Alexander Milne, St. Catharines, Ont., fourth vice-president; Mr. Charles Henderson, Waterloo, Iowa, fifth vice-president; Mr. John M. Diven, Charlestown, S.C., secretary-treasurer. The Finance Committee was re-elected.

The Trolley Ride.

On Wednesday afternoon the party was taken for a trolley ride from one end of the city to the other. Eight well-filled electric cars proceeded as far as Scarboro Beach Park at the eastern end of the city, and from that point to Sunnyside, the western limit. The journey was not made direct, and thus the delegates were enabled to see nearly all the places of interest. Arrangements had been made to visit the city's pumping station, but owing to an exceptionally heavy rain storm which came up this was impossible.

Evening Session.

The evening session was devoted to lantern illustrated talks on travel. "Some Waterworks and Other Views in Australia," by Allan Hazen, and "Some Oriental Waterworks," by George A. Johnson, were the subjects.

Thursday's Session.

Thursday was devoted almost exclusively to the reading of papers and discussions thereon. The opening paper was read by Mr. John Ericson, of Chicago, on "Waterworks Plants and the Proper Rates for Domestic and Public Service." That the cost of water used for public purposes should be shared by the whole community was his main contention.

"The Action of Water Upon Lead and Zinc" was the subject of a paper by Dr. W. P. Mason, Troy, N.Y. He quoted a recent report of the Massachusetts Board of Health as follows:—

"The board has investigated the question of the presence of zinc in drinking water supplies where galvanized iron pipes are used, and, except in case of the use of some ground waters containing very large amounts of free carbonic acid, which dissolves zinc and many other metals very freely, the amount of zinc found in ordinary water supplies, where galvanized pipes are used, is not sufficient in the opinion of the board to give anxiety."

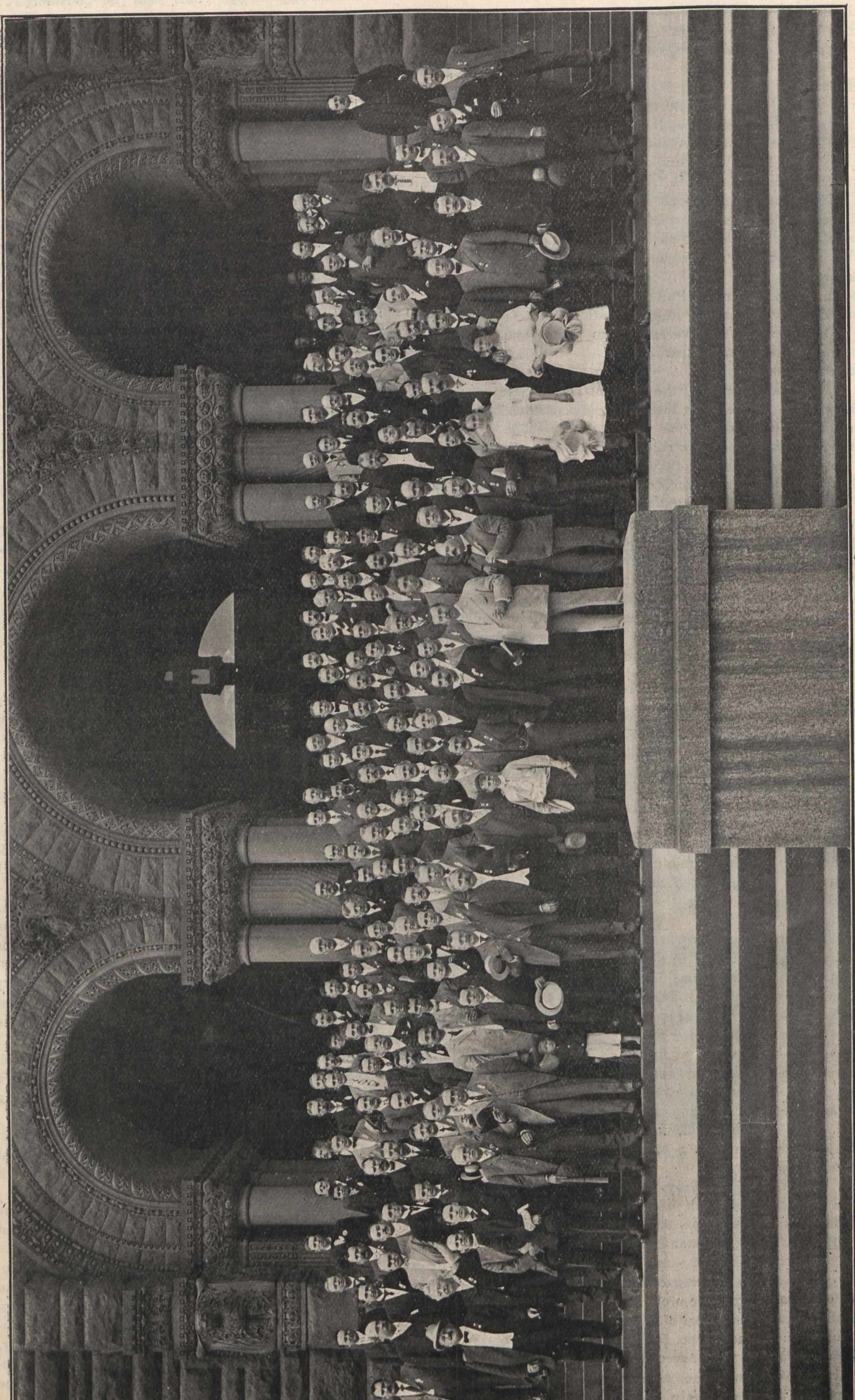
Mr. R. J. Thomas cited an instance in New Lowell where there were forty cases of poisoning from lead in a driven well. The properties which caused the poisoning were excesses of carbonic acid.

"The St. Louis Method of Purification" was the subject of a paper by Wilson F. Monfort, St. Louis, who stated that the water was purified by sedimentation basins. After it passed the first basin the water was fairly well clarified.

The proceedings moved along so rapidly that many papers scheduled for Saturday were disposed of throughout the day.

Dr. John Galbraith, LL.D., of the University of Toronto, was appointed an honorary member of the American Waterworks Association. The motion for this special appointment, which was moved by Mr. A. Milne, St. Catharines, and Dr. W. P. Mason, Troy, N.Y., stated that "Dr. Galbraith is a man of sterling worth, not alone as a professor of science, but in every other way, and at any time you may meet him."

The report of the Committee on Waterworks Standards was presented. The report dealt with specifications for cast-



Delegates and Visitors to the Convention of the American Waterworks' Association, Toronto, June 17th to 22nd, 1907. Photo Taken in Front of the Toronto City Hall, in Which Building the Meetings Were Held.

Copies of this picture printed on coated paper may be secured upon application.

iron water pipe and special castings. After some discussion it was referred back.

A committee was named to draft a resolution expressing appreciation of the courtesies received in Toronto.

"How can Politics be Eliminated from the Management of a Municipal Waterworks?" was the suggestive title of a paper by the secretary of the Association, Mr. J. M. Diven, Charleston, S.C. It had reference more particularly to American cities, where politics in a majority of cases enter into the management of waterworks owned and operated by the municipalities. Ability, adaptability, long study, and practice were the necessary qualifications for a waterworks manager, but these did not count so much as the question of political party. Mr. Diven suggested that every State should have a water and sewage commission, charged with the supervision of all plans for public water supplies and sewer systems and the endorsation of candidates for managerships. He advocated something more than this—a national water and sewage commission for Canada as well as the United States, each country to have a commission to exercise a general supervision of sewage and water matters.

An address followed on "Tuberculation and the Flow of Water in Pipes," by N. S. Hill, jr., New York. He thought the absence of available data on a subject so important spoke poorly for the initiative of hydraulic engineers and waterworks superintendents. He deprecated the burying of distribution systems under four feet of earth, leaving it to rust, corrode, fill up and putrefy, without means of access for inspection or cleaning. He confessed that a search for information as to what was tuberculation, how produced and how prevented, had been fruitful of but small results. Tuberculation was due to incrustations on unprotected or imperfectly protected iron pipes, deposits on the inner surface of iron pipes, and accumulation of debris and mud in inverts, hollows and dead ends. Mr. Hill was confident that tuberculation would not occur when the iron was effectively protected by any means from contact with the water, and suggested the advisability of equipping the pipe systems with manholes for the purpose of test, inspection and cleaning.

In the discussion which followed Dr. George F. Whitney, New York, gave some practical experiences which he had had in the cleaning of cast-iron water mains in several American cities. He had found the cleaning of mains satisfactory in every particular. An important feature of the cleaning of cast-iron water mains was the increased fire protection which resulted. In addition to other advantages there was a saving of fuel.

A paper on "Cleaning Water Mains," by Mr. Park Woodword, Atlanta, Ga., was read by Mr. C. H. Campbell, Atlanta, in the absence of the author. In Atlanta there had been trouble for years, because of tubercular growth in the pipe, and last year the situation became so bad that it was decided to clean out a six-inch pipe as an experiment. The six-inch pipe was connected with a twenty-inch main, under 53 pounds pressure 220 feet from the main. The meter, after running two minutes, registered 270 cubic feet. After the pipe was cleaned the meter registered 400 cubic feet, showing an increase of 130 cubic feet, or 978 gallons in two minutes. Other successful tests were made, and Atlanta City Council was considering the advisability of having all the mains cleaned out this summer.

Moonlight Sail on Lake Ontario.

Thursday evening was given up to pleasure, and through the courtesy of the city everyone who wore the Association badge was enabled to enjoy a sail on the lake in the moonlight. The palace steamer "Chicora," of the Niagara Navigation Company left her moorings at 8.30 in the evening, returning about eleven o'clock.

Friday's Session.

The programme for the final day's meeting contained many short papers, some of them of a highly technical character. A touch of pathos was given to the final day's meeting by the fact that the author of one of the papers on the programme, Mr. John F. J. Mulhall, Boston, had died during the week. Mr. Mulhall's paper, "A Few Experiences in the Examination of Waterworks Accounts and Management," was presented.

In the paper on "Dowsing," by Mr. Charles Anthony, jr., Bahia Blanca, Argentine Republic, who was not present, it was stated that the action of the "divining rod" was due to radial activity.

"Repairing a Broken Force Main," by Mr. C. W. Wiles, Delaware, Ohio, related the personal experience of the writer, whose chief difficulty in repairing a three or four-foot main was that the water was running through the course at the time.

Mr. T. W. Davey, Middletown, N.Y., spoke of "Stripping Reservoir Land; or, Some Methods Used for the Prevention of the Growth of Algae."

Other subjects disposed of were: "Some Personal Waterworks Experiences," Mr. L. N. Case, Duluth; "Some Experiences Met with in the Management of a Small Waterworks Plant," Mr. Howard L. Williams, Luddington, Mich.; "A Wheel Pump," Mr. H. F. Dunham, New York; "The Operation of a Pump While Submerged by Flood," Mr. E. Forest Williams, Du Quesne, Pa.; "Rates and Regulations for Private Fire Protection in Atlanta, Ga.", Mr. Park Woodward, Atlanta; "Special Fire Protection Rates and Regulations, Elmira, N.Y.", Mr. J. W. Diven, Charleston, S.C.; "Connection from Public Water Supply for Private Fire Protection Service," Mr. A. W. Hardy, Chicago.

The meetings of this convention were of the highest order throughout, and the programme was carried out almost exactly as arranged. Apparently every member came prepared to discuss the subjects under consideration, and to take home every scrap of information that was obtainable Opinions, as is always the case when a number of authorities on any subject get together, were widely different, but each member gave free expression to his views, and in this way the discussions were made highly beneficial. As can readily be seen from the titles, many of the papers were most valuable. Owing to lack of space it is impossible to reproduce them here; some of them at least will be published in future issues of the Canadian Engineer.

Saturday found most of the visitors leaving for their respective homes, each and everyone well pleased with the proceedings, and delighted with the welcome tendered them by the "Convention City" of Canada.

The following is a list of those in attendance.

Active Members.

Toronto, Ont., C. H. Rust, C. L. Fellowes, J. C. Armer (Canadian Machinery), J. J. Salmond, P. W. Ball and A. E. Uren (Canadian Engineer), W. Wingley (Plumber and Steamfitter); Goderich, W. C. Brough; Kingston, T. Hewitt; Merriton, R. Clark; Pembroke, G. H. Bigson; London, O. Ellwood; St. Thomas, J. K. Crocker; Hamilton, E. G. Barrow; St. Catharines, A. Milne; Sturgeon Falls, C. F. Gibson; Walkerville, S. C. Robinson; Ottawa, W. J. Ker; Aylmer, J. L. Millard.

New York, N.Y., F. M. Griswold, J. C. Kelley, C. A. Hague, N. S. Hill, Jr., F. W. Sheppard, T. H. Luce, D. C. Toal (Editor Water and Gas Review), W. H. Fritchman, E. S. Cole, A. A. Knudson, A. Hazen, A. S. Tuttle, G. E. Sly (Municipal Journal), M. N. Baker (Ass. Editor Engineering News), G. F. Whitney, R. E. Milligan, S. T. Henry (Engineering Record); Chicago, Ill., H. O. Nourse, J. W. Alvord, H. E. Keeler, W. N. Clakins, T. C. Phillips, C. B. Burdick, W. A. Levering, E. N. Eaton, A. T. Prentice, G. R. Basem, A. W. Harvey; Trenton, N. J., C. A. May, C. C. Engel, C. H. Young, W. H. Brokaw, J. W. Manney, C. H. Skerm; Reading, Pa., G. H. Felix, S. H. Close, E. Elbert, A. E. Leivash, E. L. Neubling; Newark, N.J., A. F. Eggers, T. F. Halpin, M. R. Sherrerd, A. P. Smith; Rochester, N. Y., G. W. Rafter, G. H. Bliven, E. A. Fisher, D. C. Little; Troy, N. Y., J. M. Caird, E. L. Grimes, W. P. Mason, J. H. Caldwell; Buffalo, N. Y., H. L. Lyon, J. F. Witmer, G. B. Bassett; Harrisburg, Pa., G. C. Kennedy, E. Mather, J. A. Affleck; Atlanta, Ga., C. H. Campbell, W. M. Rapp; Grand Rapids, Mich., A. L. Holmes, W. M. Anderson; Wilmington, Del., T. A. Leisen, P. J. Ford;

Charleston, S. C., J. M. Diven, G. C. Bunker; Atlantic City, N J., J. H. Decker, L. Van Gilder; Columbus, O., A. H. McAlpine, J. O'Shaughnessy; Philadelphia, Pa., W. F. Woodburn, H. Crowther; St. Louis, Mo., B. C. Adkins, W. F. Montfort; Pittsburgh, Pa., M. Prenter, S. A. Taylor; Milwaukee, Wis., C. J. Poetsch, W. J. Sando; Stapleton, N. Y., W. Volkhardt; Nashville, Tenn., J. T. Ahearn; St. Paul, Minn., J. Caulfield; Lowell, Mass., R. J. Thomas; Kansas City, Mo., J. F. Anderson; Hattiesburg, Miss., B Jones; Waterloo, Iowa, C. R. Henderson; Savannah, Ga., J. P. Figg; Conncant, O., L. Harvey; Sioux City, O., P. Carlin; Hartford, Conn., E. N. Peck; LaGrange, Ill., J. M. Strausser; Madison, Wis., J. B. Heim; Wellesley, Mass., F. Hersey, Jr.; Waterford, N. Y., D. B. McCarthy; Minneapolis, Minn., H. B. Gray; East Orange, N. J., A. A. Reimer; Amsterdam, N. Y., J. R. Snell; Gloversville, N. Y., A. Orr; Selma, Ala., M. L. Worrell; Meadville, Pa., H. Ellsworth; Catasauqua, Pa., W. L. Watson; Columbia, Pa., A. H. Leyers; Lane, Pa., E. T. Frailey; Waverley, N. Y., J. T. Sawyer; Waterbury, Conn., W. E. Kennedy; Richmond, Ind., H. A. Dill; Middletown, Conn., P. T. W. Hale; New Rochelle, N. Y., A. G. Archibald; Delaware, O., C. W. Wiles; Staten Island, N. Y., J. S. Warde; Pueblo, Col., A. H. Wagner, D. E. Burke; Kingston, N. Y., J. Gallagher; Ashbury Park, N. Y., J. L. Coffin; Wellington, N. C., J. H. Sweeney; Norfolk, Va., T. B. Dornin; Weehawken, N.J., D. W. French; Manisti, Mich., S. Cahill; Varauth, Pa., F. Huth; Boston, Mass., F. A. Barhm; Bridgetown, N. Y., T. Woodruff; Middletown, N. Y., T. W. Darey; Burlington, N. J., W. R. Conard; Camden, N. J., R. Hollingsworth; Phillipsburg, N. J., A. S. Corr; Florence, N. J., J. Absolom; Monongohela City, Pa., J. H. Sheppard; Greenville, Pa., T. Stowe; Lawrence, Mass., M. F. Collins; Perth Amboy, N. J., J. G. Burns; St. Paul, Minn., L. Lindley; Bedham, Mass., G. T. Staples; Morristown, Pa., R. A. Jackson; Raleigh, N. C., E. B. Bain; Butler, Pa., M. E. Wright; Wheeling, W. Va., W. Schwertfeger; Waterloo, N. Y., C. H. Ross; Erie, Pa., W. B. Dunkin; Canon City, Col., C. W. Van Patten; Corning, N. Y., W. J. Heermans; Holyoke, Mass., J. L. Tighe; Irontown, O., D. Hillark; Washington, D. C., M. O. Laighton; Jamestown, N. Y., D. W. Immel; Marion, Ind., E. Halley; Attleboro, Mass., G. H. Snell; Cincinnati, O., D. A. Brown; Paterson, N. J., A. W. Cuddebach; Canadagua, G. R. Ellis; Baltimore, Md., W. H. Wehr; Kyoto, Japan, J. Inoue; York, Pa., J. T. Sprinkle; Elmira, N. Y., H. F. Jones; Detroit, Mich., C. W. Hubbell; Toledo, Ohio., C. S. Brown; Terre Haute, Ind., D. R. Gwinn; Wellington, Del., B. F. Shaw; Cleveland, Ohio, E. W. Bemis; Peoria, Ill., D. H. Maury; Scranton, Pa., W. M. Marpel; Washington, Pa., J. V. Clark; Niagara Falls, N. Y., N. J. Canahan; Lynchburg, Va., W. C. N. Randolph; Trafford City, Pa., P. A. Monteverde; Ambler, Pa., W. J. Devine; Urbana, Ill., E. Bartow; Newport, Ky., W. L. Glazier; Evansville, Ind., J. W. Peck; Kalamazoo, Mich., W. F. Reid; Kerney, N. J., R. Veale; Cannington, N. Y., R. Welton; Zanesville, O., E. F. Mull; Ashland, O., C L. Fortney; Johnstown, Pa., T. Watkins; Salt Lake City, Utah, F. L. Hines; Newport News, Pa., F. Manville; Altoona, Pa., S. Gailey; Port Huron, Mich., H. Burton.

Associate Members.

Toronto, Ont., M. Wammack, National Meter Co.; R. A. Morrison, C. World, A. Betton, S. T. Hadlay, James Morrison Brass Manufacturing Co.; H. J. Hamilton, Drummond, McCall Co.; W. E. Gillman, Cancos Co.; F. M. Allen, Canadian Fairbanks Co. Walkerville, H. O. Kerr, Kerr Engine Co. Chicago, Ill., T. N. Johnson, U. S. Cast Iron Pipe and Foundry Co.; F. J. Bradley, N. W. Tuck, National Meter Co.; H. J. Brown, Neptune Meter Co.; J. T. Corbett, J. T. Ryerson and Son; A. T. Weaver, American Steel and Wire Co.; C. S. Francis, National Meter Co.; H F. Doran, Neptune Meter Co.; G. H. Carr, H. R. Worthington Co.; O. Jovet, Renselaer Manufacturing Co.; W. D. Hess, Builders Iron Foundry; E. G. Ladd. New York, N Y., L. H. Nash, J. C. Kelley, National Meter Co.; T. D. Faulks, F. A. Smith, H. I. Dills, C. A. Vaughan, W. L. Dillon, Neptune Meter Co.; H. A. Wilson, W. H. Drew, Clark and Cowles Valve Co.; W. T. Sherwood, Hersey Manufacturing Co.; O. B. Mueller, W. H. Van Winkle, Waterworks Equipment Co.; A. P. Foster, National Water Main Co.; L. M. Booth, C. F. Blount, Central Foundry Co.; C. H. White, Fairbanks Co.; J. N. Gregory, Dearborn Drug and Chemical Co. Boston, Mass., E. M. Shedd, Thomson Meter Co.; C. H. Mosher, American Steam Gauge and Valve Manufacturing Co.; F. E. Adams, Coffin Valve Co.; H. L. Weston, National Meter Co.; F. L. Northrop, Union Water Meter Co.; C. H. Baldwin, National Meter Co. Pittsburgh, Pa., J. H. Davies, A. D. Hays, Pittsburgh Meter Co.; J. N. Chester, E. and F. F. Woods, The Epping Carpenter Co.; H. I. Miller, T. C. Clifford, D. E. Arnold, Pittsburgh Meter Co.; G. H. Bailer, Jr., G. C. Smith. Cleveland, Ohio, W. J. Schoenberger, S. P. Schoenberger, T. B. Dailey, United Brass Co.; J. Herzbrum, J. L. Goodman, Glauber Brass Manufacturing Co.; F. W. Haultz, Neptune Meter Co. Buffalo, N. Y., L. S. Barnard, Hersey Manufacturing Co.; R. M. Hastings, H. Mueller Manufacturing Co.; W. J. Shillew, Buffalo Meter Co.: E. C. Sornberger, The Holby Manufacturing Co. Philadelphia, Pa., G. M. Costello, L. H. Carnfel, G. M. Costekko, Cancos Manufacturing Co. Newark, N. J., C. Stewart, Neptune Meter Co.; F. N. Whitcomb, D. F. O'Brien, A. P. Smith Manufacturing Co. Brooklyn, N. Y., W. S. Cetti, H. J. Putnam, S. D. Higley, Thompson Meter Co. Toledo, O., M. F. Ruge, A. S. Otis, Union Water Meter Co. Erie, Pa., T. J. Nagle, R. C. French, Hays Manufacturing Co. Troy, N. Y., F. S. Bates, J. S. Ward, Renselaer Manufacturing Co. Atlanta, Ga., P. J. Voss, W. P. Oliver, National Meter Co. Indian Orchard, Mass., H. E. Stone, E. F. Hughes, Chapman Valve Co. Decatur, Ill., H. Mueller, F. B. Mueller, H. Mueller Manufacturing Co. Youngstown, Ohio, J. H. Long, Wm. Tod. Milwaukee, Wis., I. J. Lynch, Allis-Chalmers Co. Elmira, N. Y., F. V. Wyckoff. Cincinnati, Ohio, W. E. Cox, National Meter Co. Manchester, Va., G. P. Anderson, Union Meter Co. Wakefield, Mass., T. E. Dwyer, Lead Lined Iron Pipe Co. Louisville, Ky., E. P. Koetten, U. S. Cast Iron Pipe Foundry Co. Providence, R. I., E. C. Attsins. Detroit, Mich., J. J. Hurley, Ellis-Ford Manufacturing Co. Philadelphia, Pa., E. J. Lame, R. D. Wood and Co. Indinapolis, Ind., H. E. North, Carnahan-Sherwood Co. Quincy, Ill., G. J. Fischer, Modern Iron Works. Waterford, N. Y., F. S. Robinson, Eddy Valve Co. Worcester, Mass., F. E. Hall, Union Meter Co. Minneapolis, Minn., E. W. Clark. Los Angeles, Cal., D. B. Leck, National Meter Co. Columbus, Ohio, F. E. Stevens, Adjustable Clip Co. Troy, N. Y., G. M. Keefer, Renselaer Manufacturing Co. Portland, Conn., C. E. Pratt, Anderson Coupling Co.

Guests.

Toronto, Ont., R. Harris, J. Thompson, A. McRae, L. Brown, G. C. Clarke, W. Randell, A. M. Rae, T. Walsh, J. Oustin, C. H. Ansley, S. B. Trainer, J. T. McMilken, F. Somerville, C. E. Morrison, J. Morrison, D. C. World, H. W. Berryman; St. Thomas, J. A. Bell, W. B. Doherty, S. O. Perry; Windsor, W. A. Hamahan, S. K.Peck, J. Keen; London, F. J. Darch, F. Ellwood; Hamilton, A. T. James.

Minneapolis, Minn., E. W. Clark, F. L. Schoonmaker, A. Rinkler, C. W. Holmes, H. G. McGlaskey, A. Tucker; Evansville, Ind., J. R. Goodwin, B. F. Van Bohm, W. M. Madden; Wheeling, W. Va., W. J. Scroggins, H. W. Schreibe, W. F. Jenkins, C. B. Cooke; Reading, Pa., J. J. Burns, C. L. Mall, E. Yeager, E. R. Gerber; Wilmington, Del., P. J. Ford, D. Lindsay; Chicago, Ill., J. Singher, G. W. Brown, W. H. Marshall; Worthanan, N. Y., C. G. Dickel, W. N. Eastwood; Harrisburg, Pa., E. F. Gross, J. N. Duter, Jr.; Atlanta, Ga., W. M. Capp, H. M. Erwin; Rochester, N. Y., G. H. Bliven, Jr., T. C. Lynch; New York, N. Y., S. Affleck, F. Strickland; Utica, N. Y., A. B. Tapper; Askalousa, Ia., W. Luscombe; Decatur, Ill., L. Mueller; Niagara Falls, N. Y., E. J. Canahan; Trafford City, Pa., P. A. Monteverde; Milwaukee, Wis., R. R. Watrous; Racine, Wis., W. A. Driven; Jackson, Mich., J. T. Harrison; Altoona, Pa., S. A. Gailey, Jr.; Johnston, Pa., T. K. Delany; Columbus, Ohio, J. Smith; Buffalo,

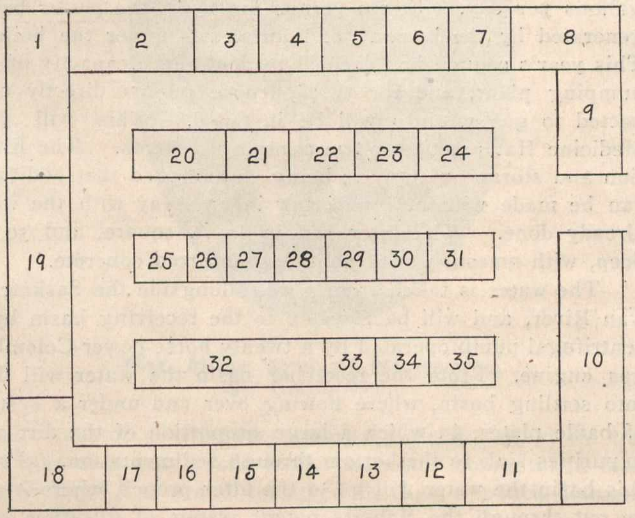
N. Y., G. M. Schmucker; Atlantic City, N. J., B. F. Souder; Newport, Ky., M. L. Glazier, Jr.; Lowell, Mass., J. G. Hill; Lancaster, Pa., C. B. Lehman; Brandford, Eng., S. Bond; Ashland, Ohio, A. F. Rupert; Jamestown, N. Y., J. F. Jones; St. Joseph, Mo., A. W. Osborne; Kalamazoo, Mich., R. R. Brenner; Marrieta, Ohio, G. M. Gadsby.

MANUFACTURERS AT THE CONVENTION.

A Convention like that of the American Waterworks' Association would be incomplete without an exhibition of manufactures, in which the delegates are more or less interested.

The display in connection with this Convention was exceptionally interesting, as only those articles that are of direct interest to the men engaged in designing, constructing, and operating waterworks plants were shown, many of them being of a type only recently placed on the market.

About thirty-five companies placed some of their products on exhibition, and many others had representatives in attendance. Catalogues, circulars, and souvenirs, specially prepared for the occasion, were freely distributed, and every possible attention was given to those who showed special interest in any of the exhibits.



Plan of Exhibits.

The room in which the display was made was adjacent to the assembly room of the City Hall in which the meetings of the Convention were held, the stalls being located as per the accompanying plan, the key to which is given below.

Key to Plan of Exhibits:—

1. Wyckoff Supply Co., Elmira, N. Y.
2. Clark and Cowles Valve Co., New York.
3. Builders' Iron Foundry, Providence, R. I.
4. Cancos Manufacturing Co., Philadelphia, Pa.
5. Coffin Valve Co., Boston, Mass.
6. The Pitometer Co., Chicago and New York.
7. Henry Worthington, New York.

8-9. A. P. Smith Manufacturing Co., Newark, N. J.

10. H. Mueller Manufacturing Co., Decatur, Ill.
11. Modern Iron Works, Quincy, Ill.
12. Ellis-Ford Co., Detroit, Mich.
13. Central Foundry Co., New York, N. Y.
14. Fairbanks Co., New York.
15. Canadian Fairbanks Co., Toronto.
16. American Steam Gauge and Valve Manufacturing Co., Boston, Mass.
17. Watkins Patent Pipe, Johnstown, Pa.
18. Hersey Manufacturing Co., Boston.
19. Jas. Morrison Brass Manufacturing Co., Toronto.
20. United Brass Manufacturing Co., Cleveland, Ohio.
21. Buffalo Meter Co., Buffalo, N. Y.
22. Glauber Brass Manufacturing Co., Cleveland, Ohio.
23. Chapman Valve Mfg. Co., Indian Orchard, Mass.
24. Union Meter Co., Worcester, Mass.
25. Ross Valve Co., Troy, N.Y.
26. Pittsburgh Meter Co., East Pittsburgh, Pa.
27. Thompson Meter Co., Buffalo, N. Y.
28. The Adjustable Clip Co., Columbus, Ohio.
29. Carnahan-Sherwood Co., Indianapolis, Ind.
30. National Meter Co., New York.
31. Lead Lined Iron Pipe Co., Wakefield, Mass.
32. Neptune Meter Co., New York.
33. Waterworks Equipment Co., New York.
34. Hays Manufacturing Co., Erie, Pa.

Wooden Pipe 42 Years Old.

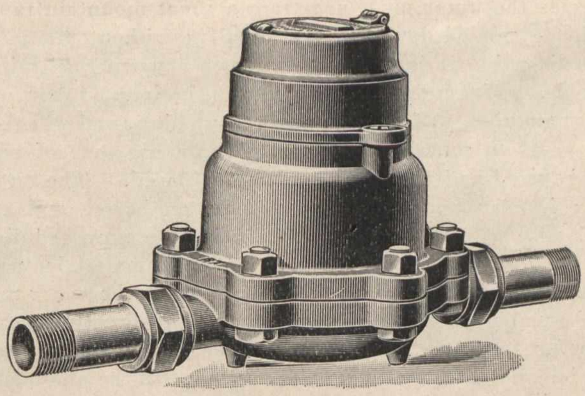
An exhibit that proved of special interest was that of the Wyckoff Supply Company, of Elmira, N. Y. This company showed a piece of wood pipe, bored out of the solid log, that had been in service for 42 years, carrying fresh water at a pressure of 30 pounds. The pipe was sawn, making it possible to see the condition of the wood, which was in a state of almost perfect preservation, and the iron bands with which it was bound showed no signs of rust. This pipe was laid by Mr. J. M. Diven's father.

The Clark & Cowles Valve Company, of New York, showed a special cut-off valve for fire hydrants, by the use of which it is made possible to turn the water off instantly without turning the hydrant off.

Other exhibits were, water meters, by Union Water Meter Company, Worcester, Mass.; Neptune Meter Company, New York; National Meter Company, New York; Pittsburgh Meter Company, East Pittsburgh, Pa.; pipe cutters and vises, by Ellis-Ford Manufacturing Company, Walkerville, Ont.; feed-water filters and water engines, Ross Valve Company, Troy, N. Y.; waterworks accounting systems, Carnahan-Sherwood Company, Indianapolis; meter seals, Adjustable Clip Company, Columbus, Ohio; lead and tin lined iron pipe, Lead Lined Iron Pipe Company, Wakefield, Mass.; water main tapping machines, Waterworks Equipment Company, New York; machine for cleaning water mains, National Water Main Cleaning Company, New York; extension service boxes, hydrants and street washers, Hays Manufacturing Company, Erie, Pa.; valves, Chapman Valve Company, Indian Orchard, Mass.; wipe joint machines, United Brass Manufacturing Company, Cleveland, Ohio; the pitometer for measuring pump slippage, etc., The Pitometer Company, New York; valves, The Glauber Brass Manufacturing Company, Cleveland, Ohio.

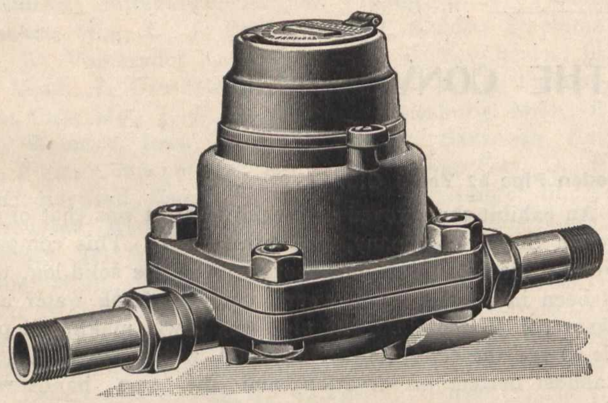
Buffalo Meters.

Buffalo water meters in the latest and most improved Niagara and American patterns, as shown at the Convention, are herewith illustrated. The Niagara pattern has an all galvanized iron outer casing and is distinguished by the square flanges held by four heavy bolts. The American pattern may have an entirely bronze outer casing or it may have a bronze top case with a galvanized iron base—in either case it is of the round flange six bolt design. Any of these meters may be supplied with straight reading dials or with standard six-hand dials, indicating in cubic feet or gallons. This variation in the dials and the outer casings permits the selection of a meter suited to any requirements at the



The Buffalo Water Meter.

most moderate cost. The working parts or actual measuring apparatus in the different patterns are always the same and interchangeable, so that all of the meters are equally accurate and reliable. The perfection of design, material,



The Buffalo Meter.

and workmanship employed in the construction of these meters, which are manufactured by the Buffalo Meter Company, Buffalo, N. Y., is the achievement of 15 years devoted exclusively to the manufacture of water meters.

A WONDERFUL WATER SYSTEM.

The city of Los Angeles in California has a population of 250,000 and is still growing. In 1901 the city acquired the ownership of the water-works. The average consumption then was three hundred gallons a day per head, the largest in the United States. With the introduction of meters this has been reduced to 120 gallons. Placing the future daily consumption at 150 gallons per head the rapidly growing city must seek its future water supply from some other source, and that source is in the Owen River Valley, more than 200 miles north of the city and high up in the mountains. This valley is about 4,000 feet above the sea level and has a watershed of 2,500 square miles. Through the valley from north to south runs Owen River carrying an average daily flow of about 400,000,000 gallons. The proposition is for the city to acquire by purchase the water rights of the valley, to dam the river 27 miles further north, and by thus diverting the river carry it by conduits to Los Angeles, 226 miles away. It will be the longest conduit supplying a city with water in the world, and with one exception, the longest for any purpose. That exception is the Coolgardie system in West Australia, where water for mining purposes is sent through a thirty-inch pipe and lifted over a mountain range 1,547 feet by pumping stations along the line. Although on its way from Owen's River to Los Angeles the water must penetrate a great mountain range it could be carried down by gravity alone without pumping or tunneling, but it is thought better to construct 28 miles of tunnels. Five miles of this work will be in solid rock, under the mountains, 14 feet wide and 11 feet high, and will require five years to complete. More than 300,000 tons of cement will be used and 5,000 men will be employed. The city will make its own cement at a cost of $1 per barrel, and a railroad will be constructed parallel with the proposed line of the conduit and over the road men and materials will be carried to the points desired. That part of the water needed for immediate use in the city can be sent directly to the intake for Los Angeles. That not needed for immediate use will be sold for irrigation. The supply will be abundant for at least a hundred years to come, if not, indeed, for ever, for the growth of vegetation under irrigation will tend to increase the annual rainfall. It is proposed to use a portion of the water for the purpose of generating the electric current and by the introduction of storage batteries a total of 93,000 horse-power will be reached, and all this without any interruption or waste of water, or the uniform flow to Los Angeles. The current will be used for lighting streets, parks and public buildings, operating electric railways and running factories. Some engineers estimate that 75,000 horse-power will be available for commercial purposes, yielding a revenue which alone would more than pay the interest on the bonds.

MEDICINE HAT'S NEW PLANT.

The Roberts Company, of Philadelphia, is now working out its contract, which was placed last summer, for the building of a filtration plant, consisting of two one-million gallon units at Medicine Hat, also the erection of a half-million gallon steel stand-pipe.

This stand-pipe has already been erected on the highest point in the city, and is now in daily use. It is one of the largest steel tanks in Canada. The idea is, as soon as the filtration system is completed to pump filtered water direct from the filters to the stand-pipe, and the city will receive its supply of water for domestic and fire purposes from this reservoir. The base elevation of the reservoir is one hundred and ten feet above the grade elevation in the business portion of the city. The tank is thirty-five feet in diameter and seventy feet high. The elevation secures an ample pressure in all parts of the city for domestic purposes and in the valley furnishes excellent fire pressure.

The present pumping plant has a capacity of 1,200,000 gallons per day. Steam pumps are used, the power being generated by the burning of natural gas under the boilers. This year's council has decided to double the capacity of the pumping plant, and for this purpose pumps directly connected to gas engines will be installed. This will give Medicine Hat practically two pumping systems. The filtration and storage plants are being so arranged that additions can be made without interfering in any way with the work already done. The filter bed is 80 ft. square, and 30 ft. deep, with masonry work done in reinforced concrete.

The water is taken from a well alongside the Saskatchewan River, and will be elevated to the receiving basin by a centrifugal pump operated by a twenty horse-power Colombus gas engine. From the receiving basin the water will flow into settling basin, where flowing over and under a system of baffle plates, in which a large proportion of the dirt and impurities sink to the bottom through sedimentation. From this basin the water will go to the filter proper, where it will be put through the Roberts patent system of filtration, and when the water is extremely dirty as it is in the spring of year when the snow is melting in the mountains, a coagulant will be added in proportion to one to sixteen hundred, and the filtered water drained into a large cement well, where it will be practically about the same level as the pumps. From here it will be pumped into the stand-pipe. This obviates the necessity of any lifting on the pumps. In the construction of the plant, provision is made for flushing and cleansing the different compartments and returning the refuse directly to the river below the intake pipe.

When these works are completed, Medicine Hat will have one of the best water works systems in the three provinces. For seven months in the year good pure, clear mountain water is taken from the South Saskatchewan River. The balance of the year, say from April until September, the water carries sediment in varying degree, caused by high water, the result of the rivers being the eastern watershed of about three hundred and fifty miles of the Rocky Mountains.

COBALT'S WATER SUPPLY.

Cobalt is experiencing considerable difficulty in securing a supply of fresh water. A system of water-works has been installed, says the "Montreal Star," draining a swamp at the back of the town and filled with decomposed vegetable matter. Recently a dead horse was pulled out of the mine, and the chairman of the Board of Health pulled out the intake pipe and Cobalt had no water.

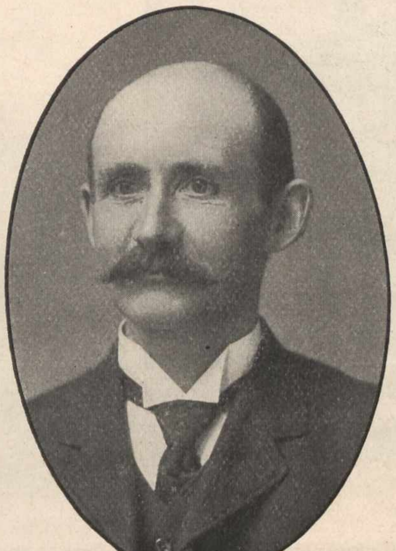
Feeling now runs high. One man is accused of using the water for his hotel, as his establishment has been watched and no other supply is available. He is also accused of bottling the water and selling it as Laurentian at twenty-five cents per pint.

Until another dead horse is found the citizens will probably continue to patronize this new water supply. The only germ that Cobalt fears is the slump microbe.

ST. CATHARINES' WATERWORKS.

The city of St. Catharines is so well known as a prosperous manufacturing community that it is unnecessary to say anything regarding it other than what is essential to the setting forth of the subject in hand.

Its first waterworks system was installed sixty-one years ago, when the present city was a mere village. As is usual



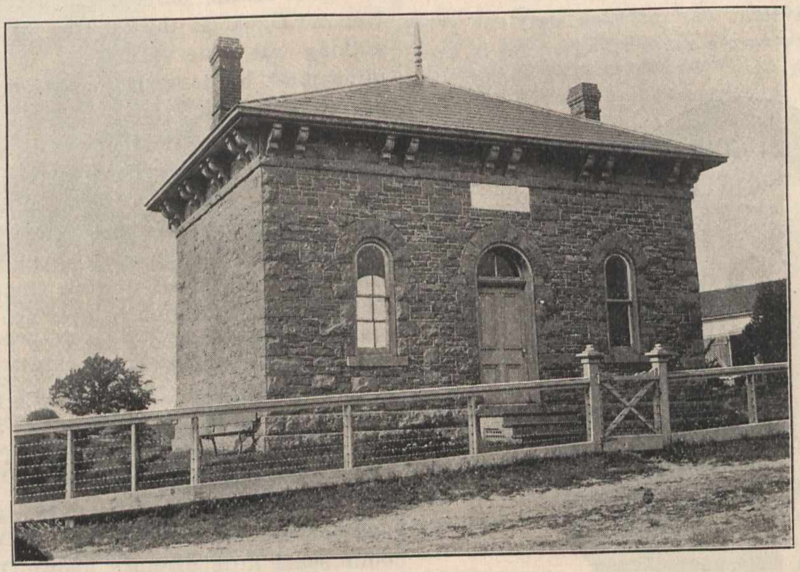
Alex. Milne, Supt. of Waterworks, St. Catharines.

in the case of nearly every embryo waterworks system this one was of a very crude kind, the water being taken from the Welland Canal and conveyed through a 5-inch diameter wooden pipe. The distribution system being composed of wooden mains. It proved so unsatisfactory that in 1885 it was decided to take the water from a point on the canal near Thorold. Two years later the Provincial Parliament authorized the construction of a system to cost not more than $200,000. In 1871 the need of fire protection was beginning to make itself felt and the City Council engaged an engineer to report on the subject. However, he was restricted to the Welland Canal as the source of supply and consequently nothing was done until 1875, when it was found that something must be done to secure for the city an abundant supply of pure water.

Thos. Munroe, C.E., consulting engineer of the Welland Canal, outlined a gravity system, and in 1876 work was begun under the supervision of a Buffalo engineer. The source of supply was the watershed of the Beaver Dam's Creek, which had an area of eight thousand acres of clay land, the creek itself flowing from the Twelve Mile Creek, which has an elevation of over 250 feet above Lake Ontario. The creek is just above De Cew Falls. At this point a surface of reservoir 285 feet above Lake Ontario and 165 feet above the highest point in St. Catharines is obtainable at a distance of about four miles, the capacity being something above 5,000,000 gallons per day. This supply has since been increased by 3,000 feet taken from Lake Erie by way of the new Welland Canal. Reservoirs were built of 43 acres storage and 10 acres distributing, an earthen dam having been built some little distance above De Cew Falls, forming a part of 120 acres, which is laid out very beautifully. A 30-inch and two 20-inch cast iron pipes with valves and intake and discharge connect these dams. The dams have a solid wall of puddle in their centre, recently anchored in a capacious trench excavated in the solid rock constituting the bed of the stream. The supply water is passed through a canal to the spillway and forms the De Cew Falls, one of the many local points of interest. The embankment of the upper dam is between 600 and 700 feet in length, and something under thirty feet high, the general depth of the water impounded being from fifteen feet to twenty feet. The lower, or distributing dam is 450 feet long, and has a total capacity of 265,000,000 gallons and an aerating pipe in operation discharging 680 cubic feet per minute to

Main Feed Weir at Allanburg.

a height of twenty-five feet. The upper dam—that devoted to storage purposes—is intended to be drawn off to the extent of ten or twelve feet down, which, when it is full, would yield 165,000,000 gallons. The valve-house, of limestone, is built on the line of the main leading into the city, nearly 100 feet from the distributing reservoir. The cistern is divided into two compartments by a stone partition.



Valve House.

At the valve-house three separate twenty-inch and twenty-four-inch mains are connected to the city twenty-inch supply main, having triplicate valves on each, a motor operates these valves. Immediately adjoining the reservoirs are the storage lakes of the Hamilton Cataract Power Company, the area of which is 570 acres. From these by agreement with the city, two twenty-four-inch pipes are laid, one to the valve-house; the other, at the dam to the storage reservoir.

Measuring Weir, City Canal—3,600 cu. ft. per minute.

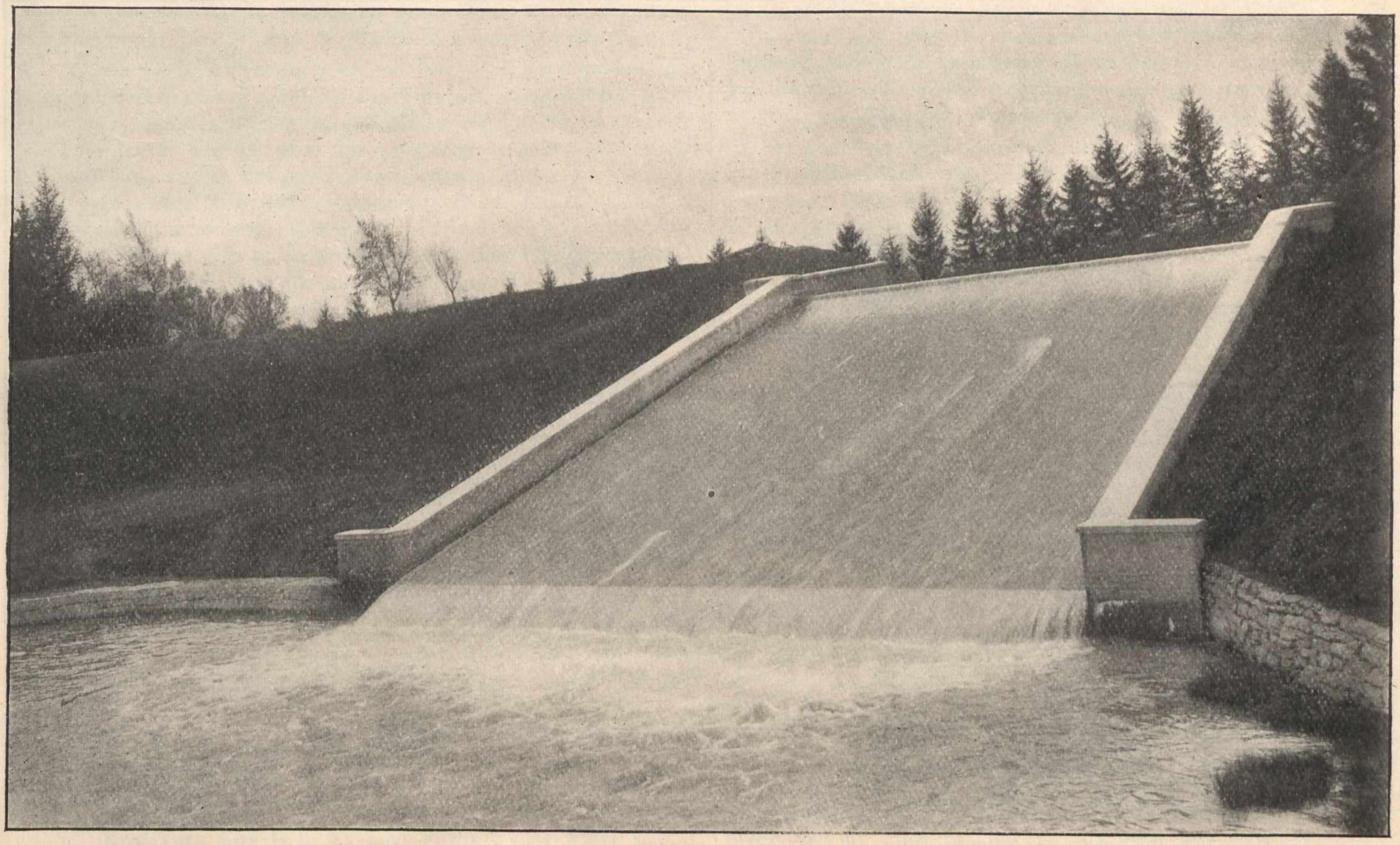
These lakes have a feed of 70,000 cubic ft. per minute from Lake Erie, and form the alternate source of supply to the reservoirs, in the event of any trouble with canals, weirs, etc. The result of this is the improvement in the quality of the water. The following advantages have accrued to the system through the agreement with the power company:—

1st. The cutting off from the reservoirs of the watershed of the Beaverdams Creek and its branches, without relinquishing the rights to the water from this source, should it ever be required, as well as the passing of the 3,000 cubic feet of water under lease from the Dominion Government, through this channel from Higgin's flume and substituting therefor an independent supply of water taken from the Lake Erie level of the Welland Canal, above Allanburg, and carried directly into the reservoir through the Cataract Company's old hydraulic canal, and the new canal constructed under the agreement, both of which have been vested in the city.

2nd. The procuring of a lease from the Dominion Government running concurrently with that of the Cataract Company for a period of nineteen years from January 1st, 1905, with two renewals of twenty-one years each, or a total of sixty-one years without any extra charge for the water so leased, viz., 3,000 cubic feet per minute.

3rd. The connection, by a 24-inch cast iron pipe, from a concrete intake pier in "Lake Gibson" so called, with the valve house and city main. This enables the commission to supply the city directly from "Lake Gibson" or to fill either or both the reservoirs from that source.

4th. This latter connection provided a means whereby the upper and lower reservoirs could be drained off (without shutting off the supply from the city) and which permitted the emptying of the lower reservoir for repairs and a thorough cleaning, the first time since its construction. It also enabled the commission to replace the 20-inch wrought iron pipe, passing from the upper reservoir through the bottom of the lower, to the valve house, and which had been defective from the first, by a 20-inch cast iron pipe. This pipe



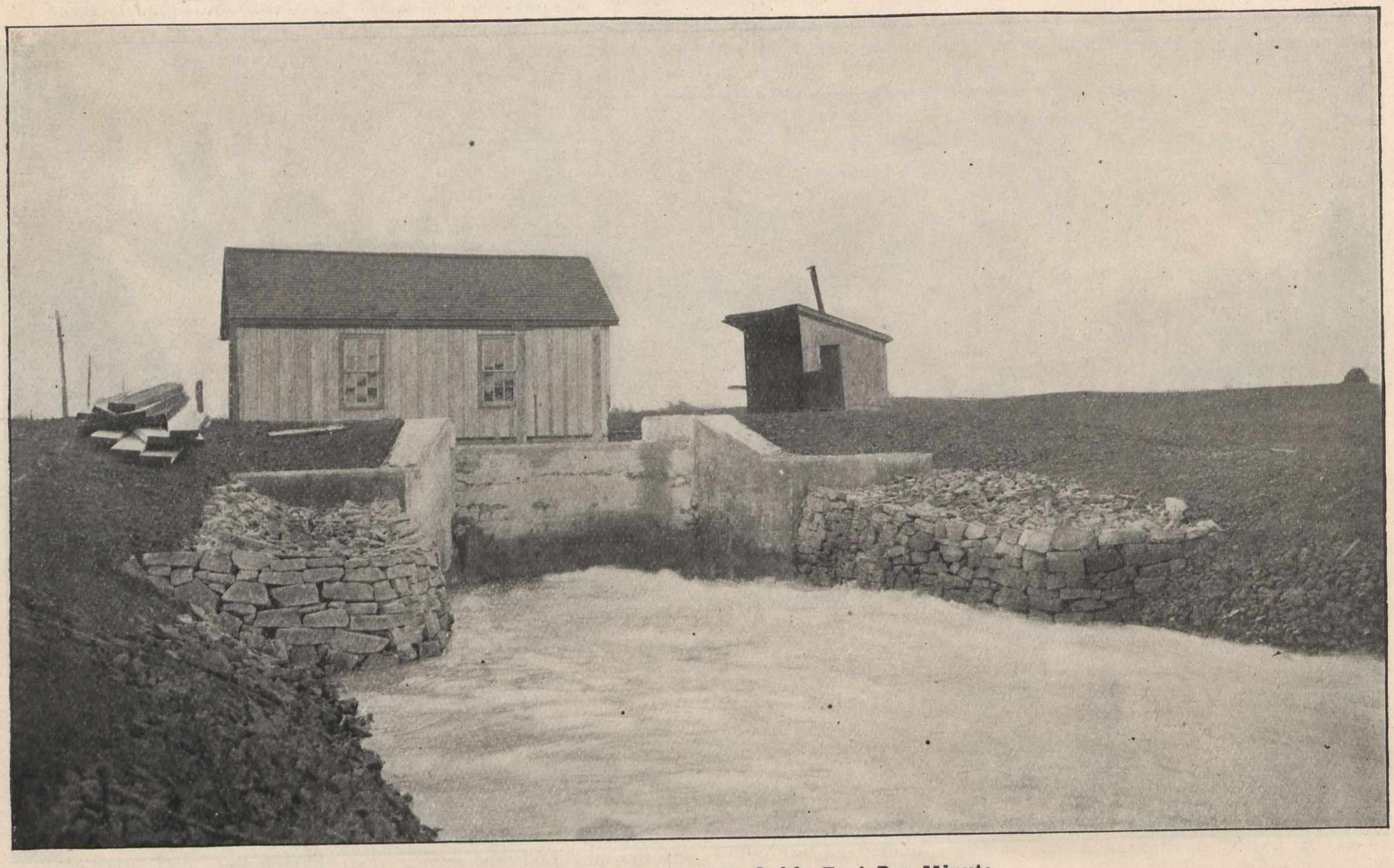
Spillway Below Reservoirs.

Intake—Twenty-four-inch Pipe Through Dam.

is also connected with the 24-inch pipe referred to in No. 3, and provides a means of filling the upper reservoir from "Lake Gibson," if so desired, as well as draining off this reservoir. From this 20-inch pipe there rises near the centre of the lower reservoir a stand-pipe, through which the water flows from "Lake Gibson," producing a fountain, the jet from which rises from 15 to 20 feet above the level of the basin, thoroughly aerating the water. This new 20-inch pipe also permits of the city being supplied directly from the upper reservoir.

5th. By a system of valves easily operated by the caretaker, water can be turned directly from the "Lake Gibson" 24-inch pipe into the city main, increasing when called for, the fire pressure by about 12 pounds.

6th. In order to retain control of the water supply from the shed of the Beaverdams Creek, a 24-inch cast iron pipe



Measuring Weir, Diverting Canal, 3,600 Cubic Feet Per Minute.

Discharge Weirs (Twenty-four-inch Pipe at Dam) and Diverting Canal.

was placed around the dam constructed by the Cataract Company at the upper end of the waterworks property, so that, if necessary at any time, this water or its equivalent can be turned into the upper reservoir. This pipe is of a capacity to supply not only Beaverdams Creek water, but also the 3,000 cubic feet under lease from the Government. The intake for this pipe is placed in a concrete pier.

7th. The reservation of 500 electrical horse-power, and the delivery of the same, by the Cataract Company for waterworks purposes at any point within four miles of the city. This power can be used for pumping or other waterworks purposes, and is delivered free of cost.

In addition to these advantages the Cataract Company obligate themselves to deliver electrical power to manufacturers in the city at 10 per cent. less than the price paid in the city of Hamilton for similar purposes.

From the new weir above Allanburg water is taken from the Lake Erie level and carried through a new canal to a point where it intersects the old hydraulic race of the Cataract Company near the new measuring weir. At this point some 9,000 cubic feet are diverted into the old supply canal of the Cataract Company and pass down the raceway to the diverting weir, where 3,600 cubic feet of water are turned into the new canal constructed by the Cataract Company for the city; from this canal, this volume of water is delivered into the head waters of the upper reservoir, by a concrete spillway.

Up to the end of 1905 the total cost of the works was $525,000, and at the beginning of last year the bonded indebtedness was $344,946 at 4 per cent. Over 12,000 ft. of wrought iron pipe have been replaced by cast iron, and some miles of new mains have been laid.

The maintenance department in connection with the system is equipped with tools of the latest type, and the manner in which the work is done is of the highest order.

During last year the storage reservoir was considerably improved, the work consisting of deepening, slope-paving, and the replacing of the original wooden crib with concrete.

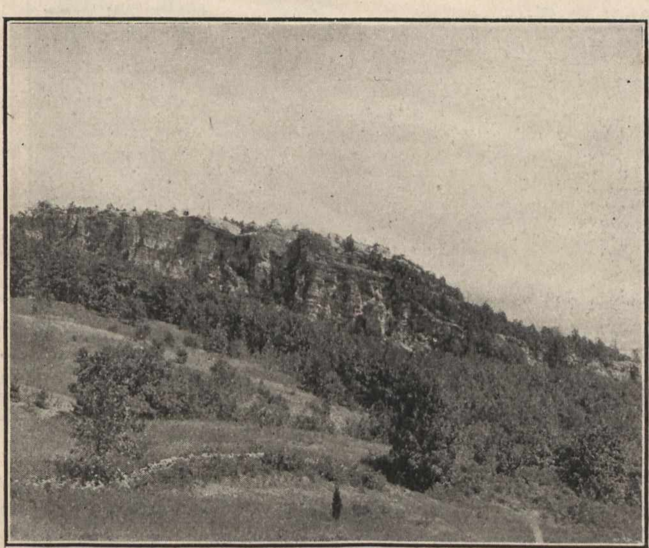
This waterworks system is in charge of a commission of six, its members being elected for a term of two years.

Superintendent Alexander Milne, through whose courtesy this article has been prepared, has strongly advocated the use of meters. The citizens, however, are opposed to this, as there is an unlimited supply, and prefer to have the duplicate main, and no restrictions. Some difficulty was experienced in laying this duplicate main, and lowering the old main 9 ft. below its original grade, but the work was satisfactorily accomplished, and both pipes are at a depth which places them out of danger should the dam give way.

At the present time the system is considerably overtaxed, so that the pressure in the mains is not what it should be, more particularly for fire-fighting purposes. This state of affairs is due to the rapid growth of the city generally, but more particularly to the number of manufacturing concerns that are locating there, and which consume large quantities of water. Before very long another large supply main will have to be run from the reservoir to the city, in order to maintain the efficiency of the system.

NEW YORK'S WATER SUPPLY.

New York City is to have an entirely new water supply, supplementary too, but wholly independent of the present system for which the water is obtained from the Croton Watershed. The ultimate cost of this undertaking will be about $162,000,000. This additional supply will provide for the immediate requirements, since the present supply is noticeably diminishing, and it will also provide for the probable water consumption of ten millions of people, the estimated population of New York in 1930.



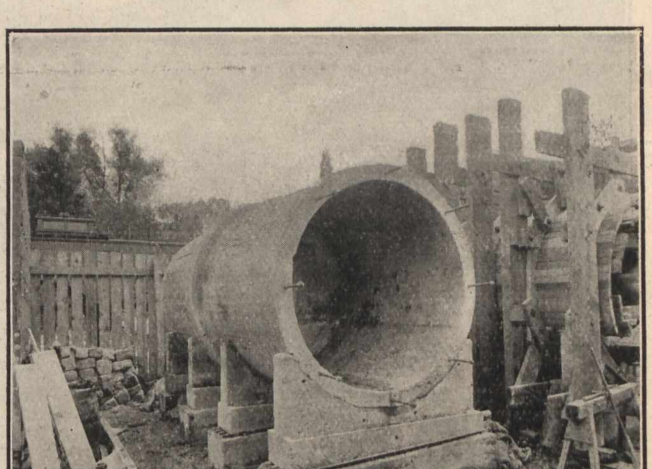
Bonticou Crag, Ulster County, New York, the base of which will be skirted by the Catskill Aqueduct.

The construction of this great work, which when completed will rank among the most remarkable achievements of modern engineering science, was inaugurated near Peekshill, N.Y., on June 20th this year, the first sod being turned by the Hon. George B. McClellan, Mayor of the City of New York.

The almost illimitable water resources of the Catskill Mountains will provide this additional supply. This area is diversified by high precipices, cataracts, and deep ravines, through many of which run streams of clear water.

An aqueduct, approaching in size the New York subway tunnel, will conduct the water to the city, passing on its course under the Hudson River in the form of a huge syphon. Reservoirs costing in the neighborhood of $20,000,000 each will be constructed at different points. A filtration plant will also be built, costing about $17,000,000.

This watershed is the eastern portion of the Catskill Mountains, draining about 900 square miles. This area is divided into four main water sheds to which may be added nine smaller ones having an area of 82 square miles. It is estimated that the yield of this total area will require a storage reservoir with a capacity for nearly 165,000 million gallons, or an aggregate daily supply of 660 million gallons.



A section of reinforced concrete pipe 5 feet in internal diameter, constructed for experimental purposes.

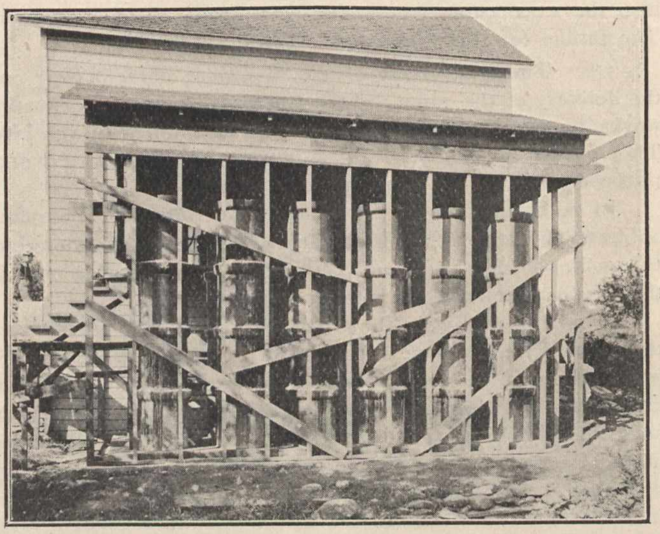
The plans of so vast an undertaking are naturally subject to some revision, conditioned as they are by the exigencies of storage reservoir construction, but the surveys made afford the certain assurance that the sources named are sufficient to supply at least 500 million gallons a day in New York City, and the whole work is designed to allow for the conveyance of not less than that quantity.

The chief impounding reservoir is to be built in the Esopus Valley. The main dam at Olive Bridge, forming this reservoir, will be 220 feet high, and with over two miles of dykes, will enclose an artificial lake 12 miles long, and from one to two miles wide, rising 600 feet above sea level, and holding over 120,000 million gallons of water. The lake will necessitate the disappearance of 40 miles of highways and 14 miles of railway, and of six small towns. From this reservoir, an aqueduct, approximately 82 miles long, and of a general diameter of 17 feet will convey by gravity the 500 million gallons of water daily to New York.

The aqueduct en route, at a height of 450 feet above the Hudson River, will dip in a vertical line to a great depth by means of a concrete syphon, or rock tunnel, it will then pass under the Hudson horizontally and proceed to the Croton watershed, under which it will pass through a straight tunnel. It will then feed a storage reservoir which will cover 2,300 acres of land and hold approximately 40,600 million gallons, giving a two months' reserve should repairs to the aqueduct be found necessary. The water will then be discharged through large filter beds, from whence it will flow to a large distributing reservoir, having a capacity of about 600 million gallons, just north of the boundary of New York City.

The filtration plant will have beds a mile in length. All water will flow through a sand-layer over two feet thick. Beneath this layer are pebbles, and beneath them stones with proportionate size and depth. Drain pipes perforated longitudinally, are laid among the stones. The sand draws off impurities, and the water, in a purified condition, is conducted by the pipes to the aqueduct continuation. One acre of filter beds will suffice to cleanse five million gallons daily.

The problem of carrying the aqueduct from one shore of the Hudson to the other has proved to be exceedingly complicated. It was first planned to cross the river near New Hamburg, and borings were begun to determine at what depth the tunnel should be cut. But it was soon found that a crossing at this point was impracticable, for the reason that there were different kinds of rock on opposite sides of the stream, indicating that there might be a fault somewhere between the two shores. The aqueduct will, however, cross at a point where a solid granite ledge can be found extending the



Experimental Tanks to determine effect of soil on water. 24-inch vitrified pipes.

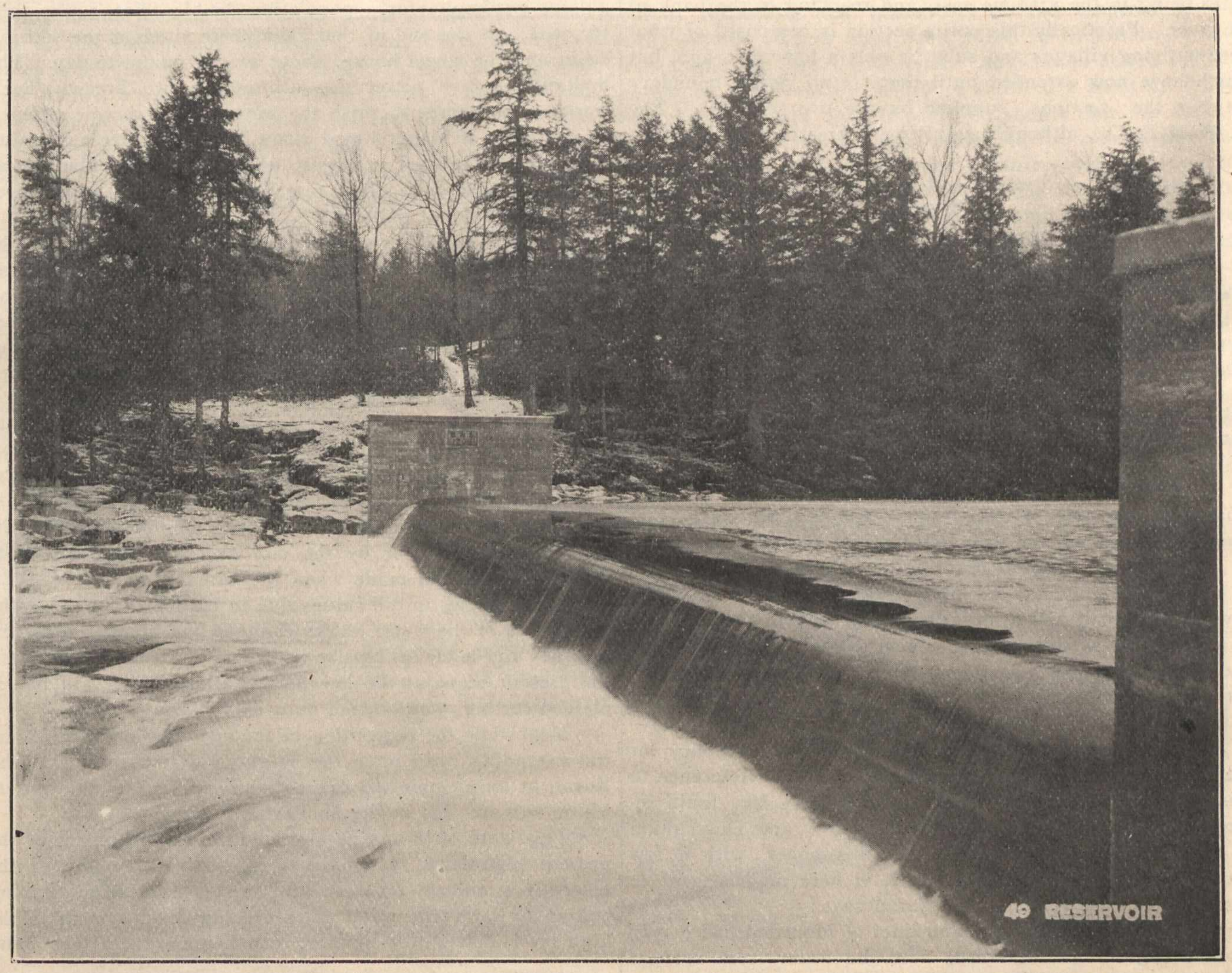
Gorge in Esopus Creek, two miles below site of Olive Bridge Dam. Note shelving character of rock.

entire width of the river. The Hudson River syphon surpasses in magnitude any other engineering feat of its kind ever attempted. The width of the stream where it is proposed to tunnel is a little more than half a mile, with a maximum depth of 130 feet, and as the plan will involve great expense it will not be absolutely decided upon until every foot of the river's granite bed has been explored and its true character determined.

The money for this enormous undertaking will be raised by long-time bonds, to be repaid from a sinking fund supplied by the increased water revenue.

Some of the most talented engineers of the United States and two members of the Panama Consultation Board have been chosen as consulting engineers in connection with the work. Mr. J. Waldo Smith, who is chief engineer of the Board of Water Supply for that city has entire supervision of the work of construction, and it is through Mr. Smith's courtesy that the accompanying illustrations are shown.

It is practically impossible to estimate the time required to complete such a vast undertaking, but it is thought that the work will not be entirely finished before the year 1920.



Weir across Esopus Creek, near site of Olive Bridge Dam, built to gauge the flow of Esopus Creek.

MONTREAL'S WATERWORKS SYSTEM.

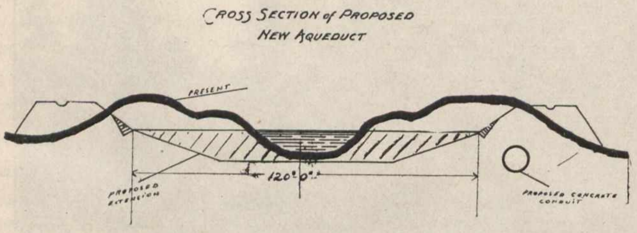
In considering the water supply of Montreal and its environs, practically only two systems need be dwelt upon. The others, such as the plant at Lachine, for the supply of that town, and the plant of the Credit Municipal Canadien, reaching from Lachine, through Notre Dame de Grace to the extreme west end of the city, and supplying a service en route, are not, as yet, of particular prominence.

George Janin, C.E.

The greater portion of the population of the city is supplied by the service owned and operated by the City of Montreal, of which Mr. George Janin, C.E., is superintendent, and Mr. T. W. Lesage, assistant superintendent, almost the entire remainder being supplied by that owned and operated by the Montreal Water & Power Company, of which Mr. F. H. Pitcher, M.Sc., is chief engineer and general manager, and Mr. W. H. Sutherland, assistant engineer.

The portion of the city supplied by the civic plant is that lying between the mountain and the River St. Lawrence. This was formerly the city proper, but owing to several suburbs having joined the city during the past few years, the civic plant no longer supplies the entire city. However, the report of the Water Works Department shows at the end of 1905 the population so supplied had reached 290,768, so that it may be said that, at the present time, the civic service is supplying a population of 300,000. The area served is about 6,000 acres.

The district supplied by the Montreal Water & Power Co. completely surrounds that supplied by the civic plant, save on the river side. Commencing on the south-west are the villages of Verdun and Cote St. Paul, and working northwards are the wards of St. Henri and St. Cunegonde, and the towns of Westmount and Cote des Nieges, the latter being back of the mountain. Then working eastward come Outremont, Ville St. Louis, St. Denis Ward, Delorimier and Maisonneuve, the latter being in the extreme east, and reaching to the bank of the river. Practically this entire section is composed of what were outlying villages and suburbs only a few years ago, but which have now extended until there is no visible boundary between the sections supplied by the two services. The M. W. & P. Co., although supplying a greater area, supplies



not more than 180,000 to 200,000 of a population, but it is fair to assume that in time to come it will outstrip the civic system.

The territory which will be served by the Credit Municipal Canadien reaches west from Westmount, through Notre Dame de Grace and the town of Montreal West to Lachine.

Before proceeding to describe the waterworks system in its present state it may be interesting to revert to the early days of Montreal, and to describe the growth of the city and its waterworks system, referring also to the difficulties which had to be overcome. In this connection, there could be no better authority than George Janin, C.E., the superintendent of the system, whose persistent efforts and plain talking have at last prevailed upon the city council to adopt a policy for the adequate expansion of the present system. Reference to this projected expansion will be made later. Mr. Janin recently prepared a paper upon the "History and Description of the Montreal Waterworks," and this paper, with a few necessary changes and eliminations, is here made use of to describe the civic service. Mr. Janin says:—

As for all old cities, the aqueduct of Montreal had a very modest beginning. Towards 1800 the water from springs was diverted from Mount Royal and distributed through some of the streets of the city in wooden pipes. In 1815 this precarious supply was replaced by a system of distribution of water pumped from the river and raised into tanks containing 240,000 Imperial gallons.* In 1845 the city bought this system from a private company, after which an epoch of progress was begun by the construction of a reservoir containing 3,000,000 Imperial gallons and situated at that time outside of the city at a place called "Cote a Baron." This reservoir, now abandoned, has been turned into an ornamental fountain in one of the squares of the city (St. Louis Square).

The time had now arrived when the intake from the river, in the middle of the harbour, and consequently exposed to all sorts of pollutions, could no longer be used with hygienic safety to supply a city full of future promise and anxious for the health of its inhabitants. As early as 1847 it had been proposed to take water at the Lachine Rapids, above the city, and to make use of the power of these rapids to raise the water, but this scheme, and others similar, were not seriously considered until 1853, when the city council concluded to confer upon Mr. T. C. Keefer, civil engineer, the duty of preparing plans for an aqueduct capable of supplying 5,000,000 Imperial gallons daily. The study of this project, its examination by consulting engineers, etc., postponed the beginning of its construction to the year 1853, and its termination to the year 1854.

The system then established included an open canal 4¾ miles long, having its entrance about one mile above the Lachine Rapids, at an elevation of 37 feet above the level of the harbour of Montreal. The dimensions of the canal were 40 feet wide at the water surface and 8 feet deep. This canal, throughout most of its course, is actually used to supply the city at present.

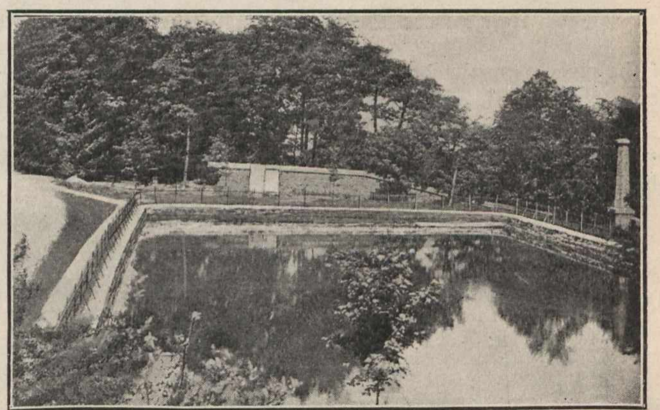
At the time of its construction this canal supplied more than sufficient water to develop 300 horse-power, and to raise 200 feet above the level of the water in the harbour 5,000,000 Imperial gallons of water, being at the rate of 40 Imperial gallons per capita for a population double what it was then (60,000). At the end of that canal were situated the settling basin and the wheel house, about as they stand to-day. The hydraulic motive power was utilized by two breast wheels working six pumps to raise the water to a reservoir situated on the slope of Mount Royal along McTavish Street, forming the present low level reservoir, which is but an enlargement of the original one. That reservoir had then a capacity of 15,000,000 Imperial gallons.

The whole of this system had been well devised for the quality and quantity of water necessary for a limited future, sufficient in fact for a population double what it was then; but the rapid increase of population, which has quintupled since, and the inconveniences produced by the severity of our winters on the wheels, have necessarily obliged the authorities of the water works to substitute turbines for breast wheels, and also to construct an auxiliary steam plant, with a view to replacing hydraulic power during the times of low water in summer, and during the winter on account of ice, frazil, etc. The steam plant was also found to be necessary to provide for the insufficiency of the water power, when the consumption of water by the city exceeded that for which provision had been made when the canal was constructed.

It was owing to difficulties due to ice formations that the authorities of the water works changed the breast wheels for turbines and made successive additions of steam pumps, until the present plant at the low level station, which will be explained further, was erected as it stands now.

Meanwhile the population of the city was increasing, and was extending itself upon the heights situated east of Mount Royal, at an altitude too great to be supplied by the system whose summit was at the McTavish Reservoir.

This state of things necessitated the establishment of the present high level system, that is, the construction of the reservoir at midway on the mountain slope, and of a pumping station to carry the water from the low level system to the high level distributing service, to a height of 422 feet above



High Level Reservoir at Mount Royal Park.

the level of water in the harbour. A Worthington steam pump, with a daily capacity of 500,000 Imperial gallons, was then sufficient to supply the high level system.

As the changes were being made to the low level machinery, as mentioned above, several schemes were prepared to put the aqueduct in condition to supply the wants of the rapidly increasing population without necessitating the resort to the expensive use of steam. All of these schemes had in view one of two objects: the increase of water power or the substitution of a gravity supply. Montreal is not advantageously situated to make use of this latter scheme. Built upon an island, bordered on one side by the St. Lawrence River—whose width precludes any idea of viaduct or syphon to bring water supply on this side—on the other side it is bordered by a branch of the Ottawa River and adjacent to another island, formed by the same river dividing itself into

* 1 Imperial gallon = 1.2 United States gallon (approx).

two branches, not so wide as the St. Lawrence River, but of sufficient width to make the bringing across of a gravity aqueduct very expensive.

To avoid these financial difficulties, nothing was left but to find north of the city a water supply taken at a sufficient altitude (that is, more than 425 feet above the St. Lawrence), adequate to the present and future wants of the city. The ridge of the Laurentian Mountanis, whose first summit is situated more than 30 miles from Montreal, was the only spot where such a water supply could be found. Surveys and levels were made, and established the fact that a water supply could be taken from Lake Ouareau, situated at an altitude of 450 feet and at a distance of about 60 miles from Montreal, but the estimated cost of such an undertaking prevented the further study of it. Consideration of the gravity plan was consequently superseded by the study of a sufficient hydraulic power system. While on this question the author would like to add that it is his opinion that the scheme of carrying water from the Laurentian Lakes would result in difficulties other than the supposed heavy cost. The water would be sure to be contaminated in a country where the watershed supplying the lakes is entirely covered with forests, where timber cutting on a large scale is constantly going on, employing large numbers of men and horses; and numbers of the creeks run nearly dry in summer and would only supply at the chosen locality impure waters. These and many other considerations were the causes which led to preference being given to the plan of the superintendent then in charge of the waterworks, Mr. Louis Lesage. This scheme was simply to carry the entrance of the aqueduct 3,000 feet up the river and to make it 130 feet wide at the water surface, 78 feet wide at the bottom, and 14 feet deep.

These dimensions would provide sufficient power to supply 30,000,000 Imperial gallons. In 1877 the construction of works on this plan was begun, the new entrance of the aqueduct was made, and the aqueduct was dug 130 feet wide for 4,800 feet in length, as it stands to-day. The cost of the work prevented its continuation, and this accounts for the periodical growth of the steam plant.

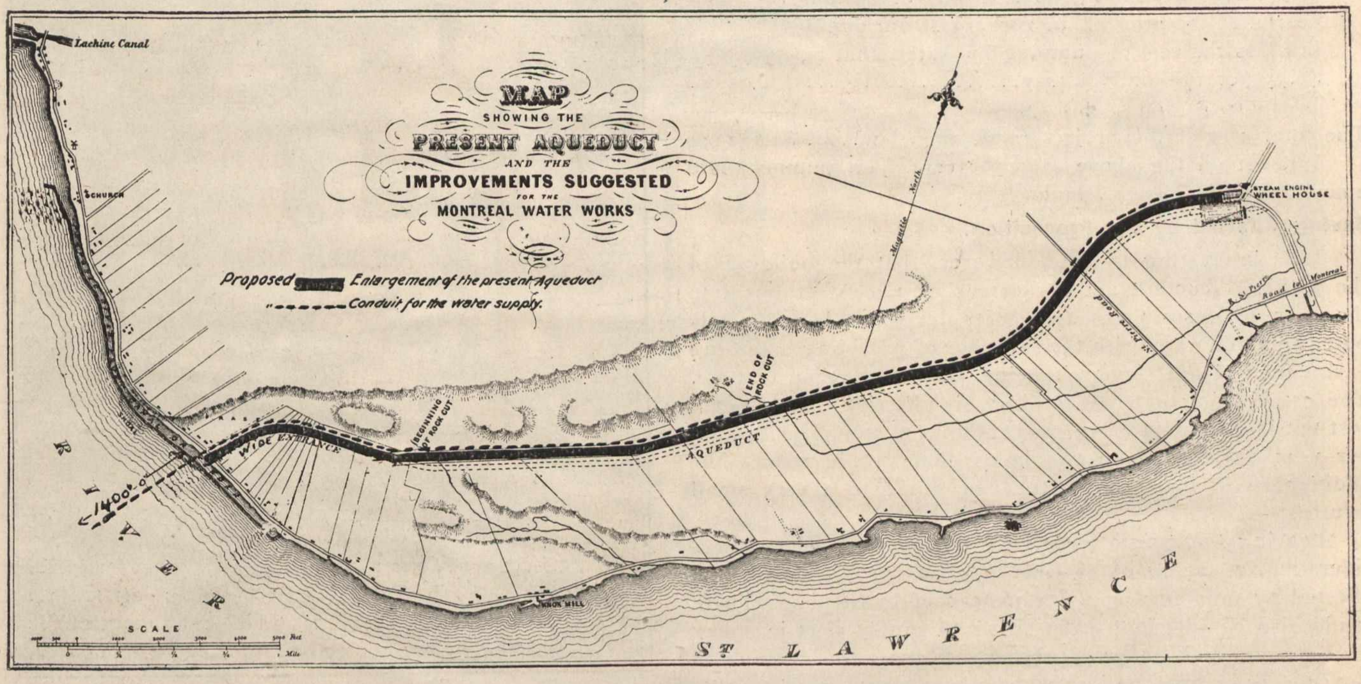
However, this beginning of enlargement had a favorable effect on the water in the aqueduct and the formation of ice, in such a way as to better protect the efficiency of the hydraulic pumps.

In 1878, the low level reservoir (McTavish) having become insufficient, it was enlarged so as to bring its capacity to 37,000,000 Imperial gallons. In 1889 the population fed by the high level system had increased so much that a new pump, of 2,500,000 Imperial gallons' capacity had to be provided for this district. This increase in the population still going on, a pump operated by electric power, of a capacity of 5,000,000 Imperial gallons, was next installed. The old steam plant is kept as a duplicate in case of emergency.

The successive changes placed the Montreal Waterworks in a position to provide a daily average water supply of about 24,000,000 Imperial gallons.

For some time past there have been outcries from various sources respecting the inadequacy of the Montreal waterworks system. These have been joined in by citizens of all grades, and the Fire Underwriters' Association added fuel to the flames by advancing insurance rates to a point at which they should remain until it could be shown that the supply was efficient. These protests, added to the reports and recommendations of Superintendent Janin, had the desired effect. Mr. Janin's proposals were gone into, and Messrs. John Kennedy and Ernest Marceau, civil engineers, were appointed a special committee to consider the proposal and report to the city council.

Mr. Janin proposed to lay a concrete conduit, with a diameter of eight feet, and walls of six inches thick, alongside the present aqueduct, this new conduit to have a capacity of about 50,000,000 gallons per 24 hours. The new conduit would be laid underground, and the water would thus be brought from the river without being contaminated en route. After the conduit was made available for supplying water, it was proposed to increase the size of the present aqueduct, giving it a width of 140 feet and a depth of 14, in accordance with the widened portion at the mouth, undertaken some years ago. The concrete conduit would supply water for consumption, the open aqueduct furnishing power for the pumps.



When completed, the entire work of pumping the water to the reservoirs can be accomplished by water-power, effecting an enormous saving. The following table shows the quantity of water pumped from this station, the methods employed, and the cost of each:—

Year.	Gallons pumped.	Power employed.	Cost
1903	3,713,220,951	Water	$ 5,277
1903	5,257,151,653	Steam	50,947
	8,970,372,604		$56,224
1904	3,616,150,841	Water	$ 4,600
1904	6,527,887,166	Steam	63,975
	10,144,038,007		$73,575
1905	3,076,348,752	Water	$ 5,364
1905	7,939,510,094	Steam	88,083
	11,015,858,846		$93,447
1906	$13,000,000,000 (est.)	Both (est.)	$113,000

Cost of Proposed Improvements.

The cost of the proposed improvements is estimated by Mr. Janin at $2,132,000, divided as follows:—

Lateral conduit in reinforced concrete to discharge 50,000,000 gallons daily	$660,000
Suction well for pumps at lower end of conduit..	20,000
Extending the conduit out into the St. Lawrence by means of two pipes, with intake pier.....	75,000
Excavations (sections 2 and 3), dry stone walls, puddling, farm bridges, stop-gates, fences, etc	817,000
Purchase of land, section 3, 20 arp, at $1,000....	20,000
Widening and deepening of tail race...........	45,000
Wheel-house, new pumping machinery, buildings, etc	300,000

(The cost of new force mains is not chargeable to the project, for, in any case, these force mains will be required when the 50,000,000 daily consumption is reached.)

Unforeseen expenditure, expropriations, surveying, superintendence, etc.	100,000
To this estimate there must be added, however, the time the carrying out of the work would take, say, three years, the cost of pumping by steam power, the water at present pumped by the water-wheel, viz., 3,616,000,000 of gallons yearly, at the price of the cost for steam pumping less the cost of pumping by water, that is, $6.75 per million × 3, say....................	95,000

The total cost of the project would then be...... $2,132,000

Interest on the above at 4 per cent. per annum would amount to $85,280 per annum.

Saving Effected by the Proposition.

It is interesting to note, however, that the building of the proposed conduit and its extension 1,400 feet out into the river, by ensuring a supply of water which is practically pure, would do away with the expenses of providing a settling basin, for which a clamor is being made from time to time. The establishing of this settling or filtration plant would cost not less than $800,000, and its upkeep would be $36,000 per year, so that these two items alone would reduce the additional cost incurred for the new works to a very small figure.

Leaving the question of the filtration plant out of consideration, a saving of at least $75,000 per year would be effected by pumping by water instead of by steam. There would also be sufficient water-power to supply electric power for lighting and other purposes, effecting a revenue of $10,000 per annum, besides which there would be a surplus of 1,500 hydraulic horse-power, which could easily be sold at $5 per horse-power, or $7,500 per annum.

Engineers Kennedy and Marceau considered the proposition, and about May 11th brought in an interim report in which they corroborated the most important estimates of Mr. Janin, and expressed their entire approval of the methods proposed by him.

The city council has now decided to push the work with vigor, and it is likely that a start will be made before August, and that the system will be ready for operation by the end of the summer of 1908.

Description of the Montreal Waterworks.

Aqueduct.—As already stated, the present source of water supply for the city is the St. Lawrence River, from which the aqueduct has its entrance 1½ miles above Lachine Rapids, 38 feet above the level of water in the harbour.

The present aqueduct, from the entrance to the junction of the old aqueduct, has a mean width of 140 feet and a depth of 14 feet, for 4,800 feet; it is then continued by the old aqueduct, which has a mean width of 30 feet, a depth of 8 feet, and is 26,200 feet long. The fall is 5 inches per mile.

The aqueduct ends at a settling basin of a capacity of 1,064,885 cubic feet, used for the distribution of the motive power to the hydraulic engines and for the drawing of water supplying the city.

At the mouth of the aqueduct a pier about 1,000 feet long has been built for the purpose of slackening the current of the river. Sluice-gates, situated at the mouth, and 2 dams with movable gates, situated in the canal, regulate the level of the water; 18 bridges cross the canal and afford the means of circulating on the roads which connect the several portions of the riverside properties.

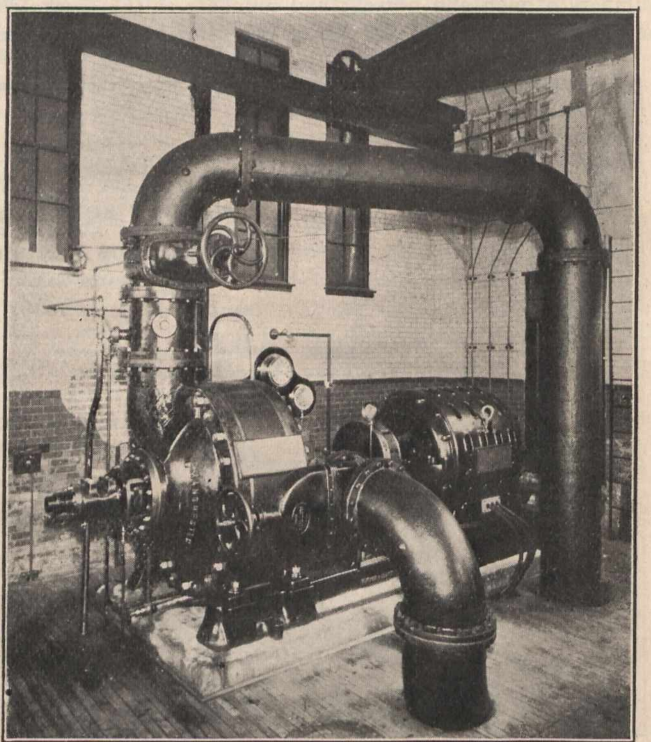
Low Level Pumping Station.—The water is raised by means of two systems—by hydraulic machines to the extent of about 60 per cent. of the consumption, and by steam engines for the balance.

The total quantity of water raised by the pumping apparatus of that station during the last fiscal year was 8,167,734,489 Imperial gallons.

There are several buildings connected with the low level pumping station, of which these are three principal ones—the first contains the turbines, operated by the aqueduct water itself, and 4 sets of pumps, namely:—

No. 1.—A Jonval turbine, with 2 double-acting pumps, which can pump 4,000,000 Imperial gallons per 24 hours.

Diameter of the wheel	8 feet.
Diameter of the pumps..........	1 foot six inches.
Stroke	6 feet.



A 5½ Million Gallon Turbine Pump at the Clarke Avenue Station of the Montreal Water & Power Co.

No. 2.—A "Samson" horizontal double wheel, with 2 double-acting pumps and an air reservoir, which can pump 5,000,000 Imperial gallons per 24 hours.

Diameter of the wheel..................	40 inches.
Width of the wheel......................	20 "
Diameter of the pumps..................	23 "
Diameter of the plunger-piston..........	20 "
Length of stroke........................	36 "
Interior diameter of the air reservoir......	30 "

No. 3.—A "Jonval" turbine, with 3 double-acting pumps and 2 air reservoirs, which can pump 3,000,000 Imperial gallons per 24 hours.

Diameter of the wheel............	6 feet.
Diameter of the pump............	1 foot 8 inches.
Length of stroke..................	4 feet.
Interior diameter of the air reservoirs	6 feet 6 inches.

No. 4.—A "Jonval" turbine, with 2 double-acting pumps and an air reservoir; capacity, 3,000,000 Imperial gallons per 24 hours.

The overflow of the settling basin and the water operating the hydraulic machines falls into a waste channel, below the building, and after a course of about 3,500 feet, flows into the St. Lawrence River, opposite the downstream point of the Nuns' Island.

The second building contains the steam-engines, comprising 3 sets of pumps, namely:

No. 1.—A high-duty Worthington engine of a capacity of 10,000,000 Imperial gallons per 24 hours.

Diameter of the high-pressure cylinder.	28¾	inches
Diameter of the low-pressure cylinder..	57½	"
Diameter of the plunger-piston.........	31½	"
Stroke	48	"
Interior diameter of the air reservoir..	39¼	"

No. 2.—A high duty Worthington engine of a capacity of 10,000,000 Imperial gallons per 24 hours.

Diameter of the high-pressure cylinder.	25	inches
Diameter of the low-pressure cylinder..	40	"
Diameter of the plunger-piston.........	27⅝	"
Stroke	38	"
Interior diameter of the feeding cylinder	35½	"
Interior diameter of the air reservoir...	23½	"

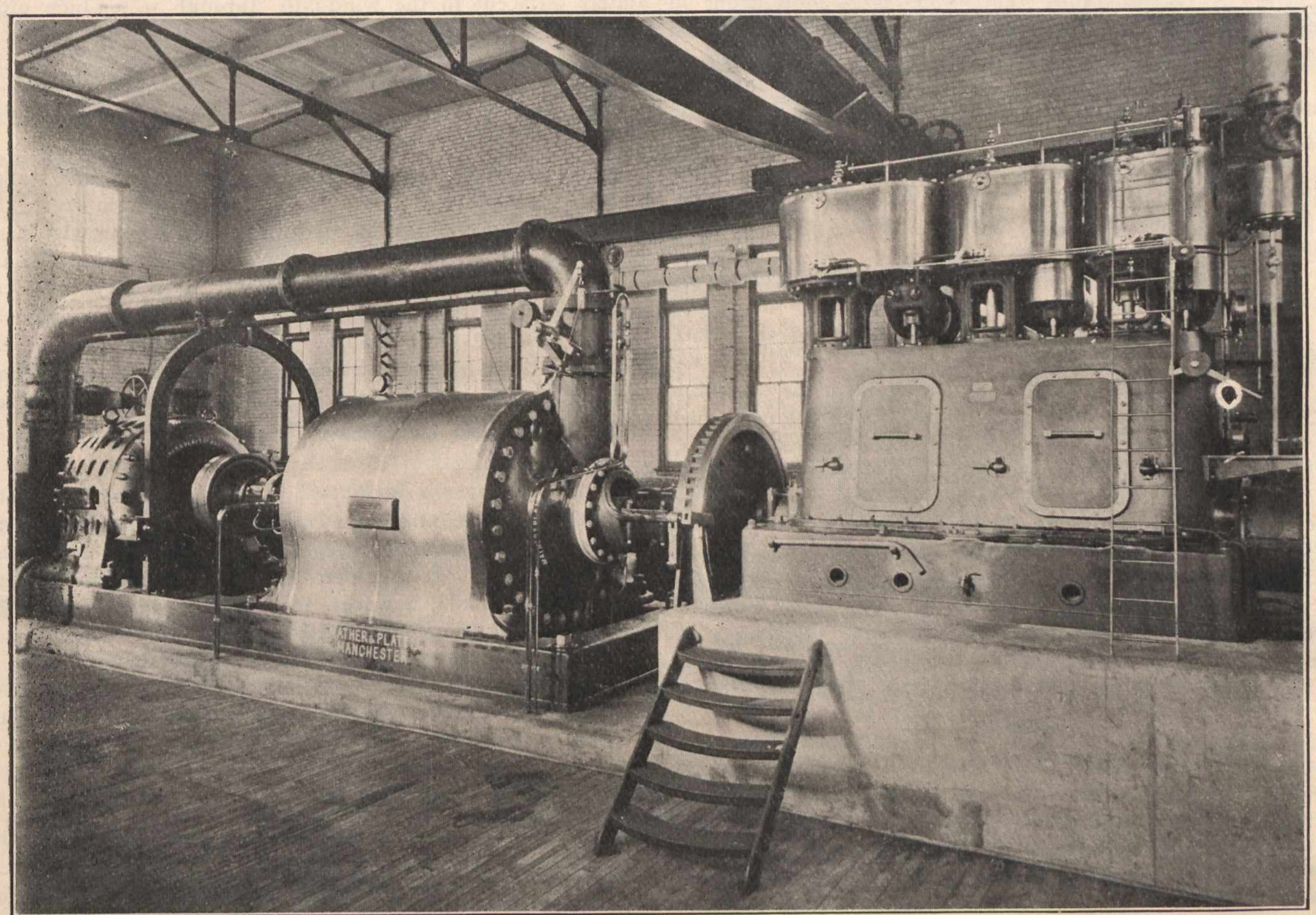
The third building contains the steam generators, which consist of 2 batteries of 3 Heine boilers each, and a battery of 3 Lancashire boilers.

The other buildings are used as sheds for the storage of coal and supplies, machine shops, and employees' dwellings.

From the pumping station the water is forced into the low level reservoir and into the pipes through two mains of 30 inches diameter, having together a length of 16,102 feet, and through two 24-inch mains having a total length of 27,709 feet.

Low Level Reservoir.—The pumps at the low level station raise the water up to the main reservoir of the city, situated at the angle of McTavish Street and Carleton Road, at the altitude of 204 feet above the river and 165 feet above the intake basin of the low level pumping station.

The said reservoir, dug into the rock, has its bottom on the uneven bed of the excavation, and its perimeter walls are partly formed by the sides of the excavation, the rest of the walls being composed of undressed stone masonry pointed with cement.



A 6½ Million Gallon Turbine Pump in use at the Clarke Avenue Station of the Montreal Water & Power Co.

No. 3.—A high duty Worthington engine (duplex) of a capacity of 8,000,000 Imperial gallons per 24 hours.

Diameter of the high-pressure cylinder.	33¾	inches
Diameter of the low-pressure cylinder..	58½	"
Diameter of the pumps..................	37¼	"
Diameter of the plunger-piston........	29	"
Stroke	48	"
Interior diameter of the air reservoir...	39½	"

A year or so ago a "Turbine," or improved centrifugal high lift pump, with electric motor and appurtenances for operating the pump, complete, was installed at the high level station, to take the place of a new electric pump which had just been installed but which, owing to its great vibration, had occasioned complaint from all the residents in the neighborhood. The capacity of the pump, like that of the one it replaced, is 5,000,000 Imperial gallons per 24 hours, or 3,472 Imperial gallons per minute, safely and continuously pumped against a total pressure of 110 pounds per square inch, including the friction of the force mains—no suction lift. The electric power is furnished from a three-phase alternating current of 60 cycles per second and at 2,200 volts.

It is divided into two equal parts by a masonry wall of the same character as the perimeter walls.

The capacity is 37,000,000 Imperial gallons of water.

High Level Pumping Station.—A building erected on the land adjoining the above-mentioned reservoir contains the high level pumping machines, which consist of 2 pumps operated by steam.

1. A high pressure Worthington pump (duplex) of 24 horse-power and of a capacity of 500,000 Imperial gallons per 24 hours. (This pump is almost unfit for use.)

2. A high pressure Gilbert pump (compound system) of 250 horse-power and of a capacity of 2,500,000 Imperial gallons per 24 hours.

The steam is supplied by a sectional tubular boiler of the Caldwell high pressure type, 200 horse-power, fed by 2 American mechanical stokers.

Old boilers of the locomotive type of 120 horse-power each are still used during the cleaning, or when accidents take place to the Caldwell boiler.

The pumps take the water from the low level reservoir and raise the same by a force main of 20 inches and 12 inches diameter and 1,674 feet long, passing through McTavish Street, Pine Avenue, Mount Royal Park, and ending at the high level reservoir, situated on the slope of the mountain, opposite Peel Street, at the altitude of 434 feet above the river and 230 feet above the low level reservoir.

The installation of a new 12,000,000 Imperial gallon steam pump, ordered a couple of years ago, is now being completed at the low level station. The specifications called for a pump with a capacity of 8,333 Imperial gallons per minute, safely and continuously pumped against a total pressure of 86 pounds per square inch, including the friction of the force mains. The suction lift is to be from 5 to 9 feet, and the pumps are to have an initial steam pressure of not over 140 lbs. per square inch. The pumping must be done with a guaranteed efficiency of not less than 140,000,000 foot pounds duty, per 1,000 pounds of dry steam. All the material of the pumps and the parts used in it are to be of the very best quality and design.

High Level Reservoir.—The reservoir is built about in the same way as the low level reservoir. It is composed of only one compartment.

Its capacity is 1,750,000 Imperial gallons; it equalizes the water supply, and contains the reserve for the section of the city supplied by the high pressure.

Distribution System.—In addition to the force mains raising the water into the reservoirs, the distribution system of the city is composed of 1,159,326 feet or 212 miles of cast-iron mains.

The distribution of water by these mains is regulated by means of 3,082 valves of various diameters.

These mains supply 1,772 public hydrants and 58 private ones.

They are all laid underground, in cut, with the exception of a portion of the 24-inch force mains, which are contained in an underground gallery for a distance of about 120 feet, from the Carleton Road crossing to the low level reservoir.

The water is distributed to the ordinary consumers by free cocks and to manufacturers, etc., by meter.

In order to complete the description of the system mention should be made of the central shops and stores, situated at the corner of St. Charles Borromee and Lagauchetiere Streets, in the centre of the city, and the secondary shops on Cadieux, Grand Trunk, and Desery Streets, which provide for the wants of the service in the distant wards."

WATER WORKS OF SHELBOURNE.

By W. L. Smith.*

Shelbourne gets its water supply from an artesian well located on a high elevation in the village. This well is 419 feet deep, and rock is reached at 110 feet. From the surface to a depth of 50 feet the well is 7 feet in diameter, and is lined with brick laid in cement mortar. From the foot of this wall down to the rock the well is lined with a six-inch oil-well casing. The water from this well has proved entirely satisfactory, and although the quantity available is not known, it is ample to supply the pump at all times.

Windmill Pumping.

The unique feature of the Shelbourne system is the method of pumping, which is done by means of a windmill.

The Windmill.

This mill is erected directly over the well. The trestle work is of timber, 82 feet high, supported on stone foundations. From the surface of the ground to the axle of the wheel is 115 feet. The windmill is 30 feet in diameter, of the "Halladay" type, manufactured by the Ontario Wind Engine & Pump Company. It is a sectional wheel made of Canadian pine, and will, with sufficient wind velocity, generate 12 horse-power. In excessive wind with small load it is governed on the same principle as the steam engine. That is, as the speed increases, small weights connected with each section fly out, thereby opening the sails and exposing less surface to the wind—the wind passing through the wheel. As the velocity of the wind decreases, a weight at the back acts as a counter balance and brings the wheel back to work again. The wheel is kept facing the wind by a vane at the back which serves as a rudder. When not required the windmill may be held at rest by means of a lever fixed at the bottom of the tower. A very simple arrangement provides that when the elevated tank has been filled, the overflow from it fills a box attached to this lever, and the wheel is stopped automatically, but will start again when the box empties, which it does in about an hour.

The capacity of the wind-mill and pump attached is estimated at 25,000 gallons daily. The pump is double acting, and is below the mill, inside the brick lined portion of the well.

The Elevated Tank.

The water is pumped to an elevated wooden tank immediately adjacent to the wind-mill, through a ten-inch pipe. The tank is 20 feet high and 30 feet in diameter, and will hold 80,000 gallons. It is made of 3-inch soft pine. From the surface of the ground to the bottom of the tank is 60 feet, making the top of the tank 80 feet above the ground. The support is a timber trestle.

The 10-inch pipe leading from the pump to the tank stands centrally beneath the tank. As a protection from frost, the pipe is first closely boarded up with a tight boxing just large enough to surround it. Four upright posts near the pipe are boarded up, both inside and out, with matched boards, tar paper forming an additional layer. This construction is such as to leave three dead air spaces. Further care is exercised in the tank itself, which is floored with matched lumber and a ceiling placed in it of the same material, dead air spaces being thereby formed above and below.

Street Mains.

Under the first contracts as carried out in 1889, mains were laid on the main business streets only, the object of the system being, for the greater part, fire protection. Service connections were made, however, for domestic purposes. The pipe at that time consisted of 2,200 feet of 8-inch pipe.

In 1900 it was decided to extend the system to provide a more general system of domestic supply, and a 4-inch cast iron pipe is now laid throughout the village, the total length of street mains being 13,000 feet.

Fire Protection.

There are 21 fire hydrants on the system. The pressure available in the business portion of the town is 55 pounds per square inch. This is sufficient to carry a stream of water over any building within the corporation, and affords a measure of fire protection such as few places the size of Shelburne possess.

In 1901 a second well was put down at the south side of the town, a supply of water being obtained at a depth of about 80 feet. A 16 feet steel wind-mill pump, direct to the main, supplementing the work of the other mill and rendering more certain the supply of water for the largely increased service. This mill and pump was also put in by the Ontario Wind Engine & Pump Company. Mill, well and site costing approximately $1,000.

Cost of Construction.

Debentures to the amount of $12,000 were issued to cover the first construction, and in 1900 debentures for $5,000 were issued to cover the cost of extension of street mains, a total of $17,000. This amount, however, did not cover the cost of construction, which was approximately $21,000, including the auxiliary well.

The total expenditure for the system since it was started, up to last year, was $24,747.61, an average per year of $1,237.38.

The cost of maintenance has been very light, averaging less than $200 annually. In addition to this has been the

* Village clerk, Shelbourne, Ont.

attendance of the caretaker, who combines with this office that of village constable, caretaker of town hall, fire hall, repairer of side-walks, etc.

The town makes the connection from the main to the point where the service enters upon the property to be served, the owner extending as he sees fit and paying therefor. In some years the number of new services has been greater than in other years, and repairs to tank, tower and pump have had to be made occasionally, causing the expenditure to vary. The cost of new services should properly be charged to cost of construction, but being put in at different dates they appear under the head of waterworks expenditure, and are included in the average given above. There are now about two hundred (200) services, yielding a revenue in 1906 of $1,082.45. The number of services are increasing each year.

To this should be added an estimate of the value fire protection which, at $30 each for twenty-one hydrants would represent per year $630.

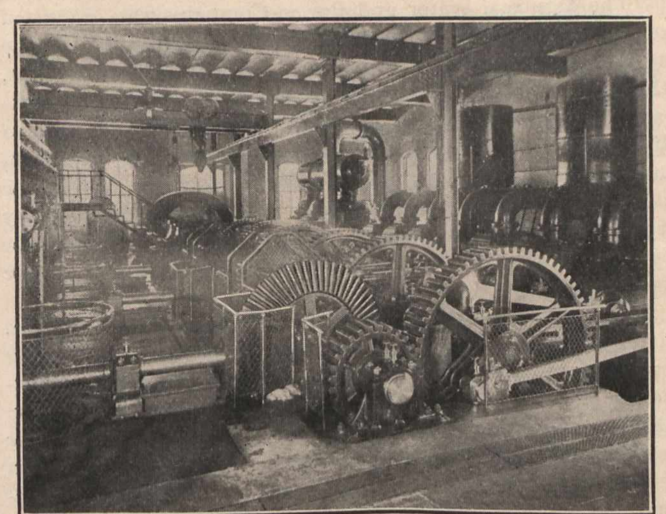
The only serious difficulty has occurred during a month or two of the summer season, when the velocity of the wind has, at times, been insufficient to operate the wind-mill. While this has been the case for only a short period, it is at a season when there is the greatest use of water for lawn purposes, and the amount of water stored in the tank has been reduced to a very narrow limit.

An arrangement has been made whereby the engine of the Electric Light Works, adjacent to the tank, can be attached to the pump whenever necessary to keep stored a safe amount of water. The town pays fifty cents an hour for the actual time water is pumped in this way.

OTTAWA'S WATER SUPPLY.

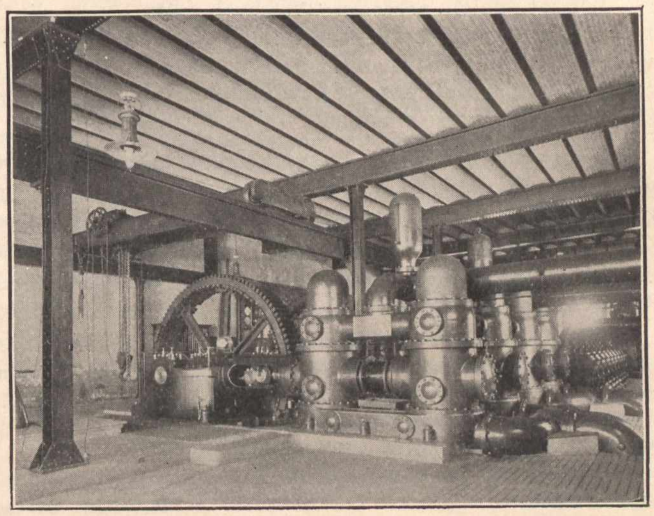
According to the annual report of the waterworks committee of the City of Ottawa, the water of the Ottawa River reached a lower level in the summer and autumn of 1906 than any level heretofore recorded, and it was so low in the latter part of the season that a section of the clear water intake pipe was partially exposed, so reducing the capacity of the pipe as to supply at times barely enough water to meet requirements; the lowering of this pipe will be commenced in the near future.

Should a satisfactory arrangement be made with the lessees of the hydraulic lots at the Chaudiere and the power owners on the Quebec side of the river, to construct the proposed horseshoe dam above the Chaudiere, the water level would be raised several feet and the necessity for a new clear water pipe and aqueduct would be done away with for some time. If matters are allowed to remain, says the report of Mr. Newton J. Ker, manager of the Construction Waterworks, a new aqueduct or the enlargement of the present one, with an additional intake pipe in either case, will be necessary.



Pumping Station, Ottawa. Nos. 1, 2, 3, and 4 Pumps.

The system now in use is a direct pressure one without a reservoir. The entire capacity of the pumping plant is about 24 million gallons per day, and is operated by turbines under a 25 foot head. The plant at present comprises six pumps, as shown in the accompanying views. The smaller sets, Nos. 1, 2, and 3 have been in commission since 1874, and were installed by the Joseph Hall Company, Ottawa.



Pumping Station, Ottawa. Nos. 5 and 6 Pumps.

Set No. 4 was built in 1890 by the Kingston Locomotive Works, while Nos. 5 and 6, built by the Kerr Engine Company, Walkerville, were the last installed, and have been in use about fifteen years. The plant is to be increased in the near future by another set similar to those of Nos. 5 and 6.

DISCOVERING LEAKS IN WATER MAINS.

A new method of locating leaks in water mains is described in a recent issue of La Technique Sanitaire. The discovery was made in Geneva, Switzerland, and the details of the work have been given by A. Betant, engineer and director of the waterworks of that city. Leaks of any magnitude will show themselves at the surface in the shape of moisture in all forms of soils except those which are very porous. It is claimed that this method will reveal exceedingly small leaks (a one-half gallon leak per minute having been detected from a pipe of sixteen inches diameter, and in ground where the surface remained quite dry). It was found that snow or frost over a trench thaws in the morning sun more rapidly immediately over the leaks than at other positions. Upon investigation it was found that the water escaping from the pipes at such a time had always a temperature of from 41° to 43° F., due, it is thought, to the heat contributed by the escaping water. This method is evidently applicable only during certain seasons, when the ground has a light covering of snow or frost, and its temperature is raised from well below to slightly above freezing. In three days at Geneva thirty-eight leaks were discovered from which a total of 136 gallons a minute, or about 200,000 gallons a day had been leaking, the pipes being from about 24 inches to about 2½ inches in diameter. Snow has been found to be a more sensitive indicator than frost, and the observations are best made when the frost or snow begins to thaw.

WATERWORKS AT MACLEOD.

The town of Macleod, Alberta, will probably have their new waterworks plant in operation some time during July. This plant is to be equipped with every modern improvement for economy and efficiency. The pumps were built by the John Inglis Co., Toronto, and are of the Worthington pattern, in duplicate, and compound condensing, with a capacity of 750 imperial gallons per minute each. Two Robb-Mumford boilers, rated at 120 horse-power each, will be installed in conjunction with these pumps. A steel tower 110 feet high and a tank with a capacity of 100,000 imperial gallons complete the system.

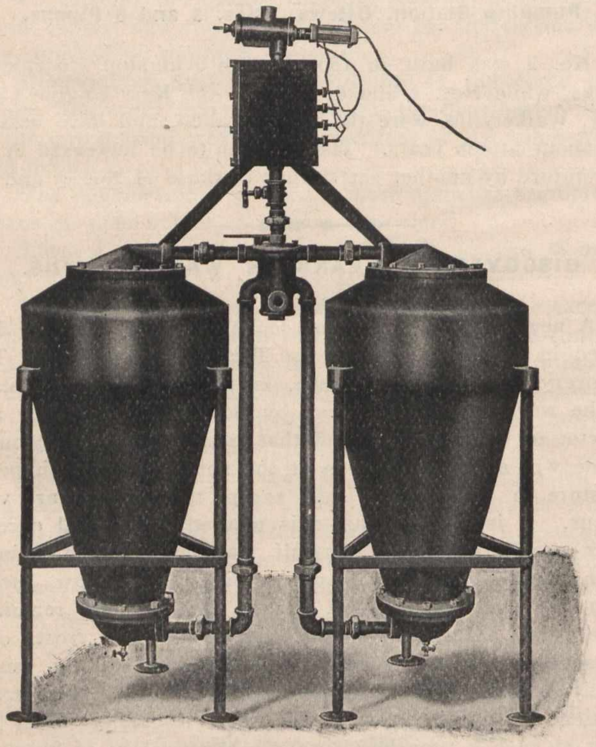
THE PURIFICATION OF WATER BY ELECTRICITY.

By C. H. Hansen, M.E.

It is absolutely necessary that pure water be supplied to towns and cities in order to maintain health. In fact pure water is an essential wherever man is found. Without water existence is practically impossible, and, therefore, the supply should be the purest obtainable.

Competent authorities state that human beings do not drink enough water to properly repair and cleanse the system. In order to maintain a maximum state of health a certain amount of pure water is necessary. The problem that is presenting itself to the civilized world to-day is how to obtain this necessary supply.

Science has shown that many diseases are carried and propagated by water. Typhoid fever, many insidious forms of malarial fever, and dysentery, are a few of the ills that might be mentioned as being almost invariably carried by drinking water.



The Hinkson Electrical Purifier.

It is well known that the water supply of a great many cities and towns is not as pure as it might be; some are far from being pure. Many methods of purification have been proposed and tried. In some cases a natural watershed has been made use of; for instance, New York City and Altona, Pa., together with several cities of Europe. This method, however, will sooner or later prove impracticable, since on account of the increasing population it will be impossible to avoid contamination.

Filtration is another method that has been resorted to. Filters of almost every description have been used, or are in use at the present time. There is, however, a great objection to these filters. They merely clarify the water, giving it a sparkling appearance of purity. The filter soon becomes contaminated with germs and bacteria, and is worse than useless for the work it is supposed to perform.

Chemical methods for exterminating the germs in the water have been tried, and have been shown to be objectionable when used in drinking water, as it is impossible to remove the chemicals used.

The purification of water by heat, boiling or distilling, while killing the germs, is also objectionable. This process makes the water unpalatable, as it removes the natural gases. It is also, as are the filtering and chemical processes, too expensive for general use.

Purification by Electricity.

It has long been known that electricity will decompose water into its elements; hydrogen and oxygen. Only during a comparatively recent period has it been found that not only does this decomposition occur, but at the same time the animal and vegetable impurities present (and to a large extent also the mineral substance) are rendered inert. This action is due to the fact that when oxygen is set free from water by the current of electricity, it is liberated in its nascent, and to a certain extent, in its ozonized form and will then energetically destroy all lower forms of animal and vegetable life so that when a current of electricity is passed through water the hydrogen, the nascent and ozonized oxygen are produced and these gases, especially the latter, so effectually kill and coagulate the dangerous organic impurities that they become inert and might easily be removed by filtration.

A number of attempts have been made to utilize this wonderful effect of electricity for the purification of domestic water supplies but most of them have been complete failures for various reasons, but mainly because the apparatus devised proved to be too complicated and expensive, and failed to treat a sufficient quantity of water.

We must, therefore, recognize as a distinct and valuable achievement the apparatus devised and patented throughout the world by Mr. F. B. Hinkson, known as the Hinkson Electric Liquid purifier. It carries out the principle of oxidation, coagulation and filtration of water by electricity in such a manner as to furnish an absolutely organically pure water in any quantity required at a cost not exceeding one-half cent per thousand gallons. It can easily be attached to any water supply, as it does the work under 100 lbs. pressure, and does not retard the flow but 1½ per cent.

The electricity may either be direct or alternating current as supplied by the light companies, or may be furnished by dry cells, or batteries. The apparatus is designed so that it is only using current while water flows through and shuts off immediately the water is turned off at the spigot. The economy of this device is obvious.

The advantage of the large supply of water this machine is able to furnish cannot be overestimated.

The Hinkson Electric Liquid Purifier applies the principle of sterilizing water by electricity in such a manner as to furnish an abundant supply of pure sparkling water throughout any building at a minimum cost, through an apparatus that is simple in its construction, effective in its operation, and which can be kept free from contamination.

THE MONTREAL WATER AND POWER COMPANY.

The Montreal Water and Power Company was organized some years ago for the purpose of supplying water to the portions of the rapidly growing suburbs, such as Westmount, which were not being served by the city plant. The company first thought of taking their water from the Ottawa River, which bounds the Island of Montreal on the north, and of deriving the pumping power from the fall in the river, which takes place there. This scheme was shortly abandoned and the intake was placed near Nuns Island or Verdun, in the St. Lawrence River, below the foot of the Lachine Rapids.

The water is forced up to the slopes of the mountain, giving a direct supply to customers, en route. A pumping station situated on Clarke Avenue, well up the hill, in Westmount, forces the surplus into the company's reservoir. This is situated on the top of the height, as one crosses over between the mountains at the head of Guy Street. From here the water is distributed to the various sections, both behind the mountain and to the east and west.

The possibilities for expansion in the service of the company are enormous. The island stretches for miles in every direction, save in the section supplied by the civic service, and the population is bound to increase enormously in the near future. It would, therefore, seem that nothing but failure to anticipate the wants of the people can prevent a proportionate expansion.

The main pumping station is situated on the bank of the St. Lawrence and the water is received direct from the river through a 36-inch wooden pipe into two wells, one under the steam plant and one under the electric plant.

The equipment consists of the following pumps:—

Holly crank and flywheel, 4 cylinder cross compound pump—capacity 1,000,000 gallons per 24 hours. (Very old, not in use.)

One Snow duplex compound low duty pump—capacity 3,000,000 gallons per 24 hours, and one of 2,000,000 gallons.

Northey triplex geared electric pump, driven by S. K. C. Synchronous motor—capacity 5,500,000 gallons per 24 hours.

Northey duplex geared electric pump, driven by same motor as triplex—capacity 2,500,000 gallons per 24 hours.

Northey triplex geared electric pump, driven by Bullock induction motor—capacity 5,750,000 gallons per 24 hours.

The discharge of these pumps is conducted through three mains—12-inch, 14-inch and 24-inch—respectively, to the north side of the Lachine Canal where they feed the distributing system. A 36-inch steel main is being laid at present parallel to the 24-inch, and will be completed by 1st August, 1907.

The overflow from this system is conducted through two 14-inch pipes to a well at the Clarke Avenue pump station, at an elevation of 200 feet from the river.

The 36-inch main above mentioned will be continued up to feed this Clarke Avenue station, as the capacity of the two 14-inch mains is insufficient to meet the rapidly increasing consumption.

At Clarke Avenue station there are two Mather and Platt high lift turbine pumps, one two chamber running at 740 r.p.m., and having a capacity of 5,500,000 gallons per 24 hours, and one six chamber running at 350 r.p.m., and having a capacity of 6,500,000 gallons per 24 hours. These are both run by induction motors, also made by the Mather & Platt Company.

The larger turbine is provided with a Belliss & Morcom triple expansion engine, which can be coupled up by means of a flexible coupling in case of failure of electric power.

These pumps supply the high levels in Westmount and the towns north and east of the mountain, the surplus going into the reservoir, situated in Cote des Neiges, which has an altitude of 460 feet.

There are 106 miles of main pipe in the system and 23,587 service branches. The population supplied is 128,000, and the average daily consumption is about 14,000,000 gallons.

PUMPING BY GAS AND OIL POWER.

The advent of the centrifugal and turbine pump has made it practicable to drive direct or by belt from a steam oil or gas engine or electric motor. When the enormous economy which could be effected by substituting suction gas or oil for steam became more fully recognized, many new pumping plants were installed, until to-day they are found working satisfactorily in varied capacities. So great have been the advantages derived from them, that in many cases the old style of pumping is being given up in existing pumping stations, and new pumps driven by these engines are being installed in their place.

In cases where power is required for a short time only suction gas plants and gas engines are eminently suitable The engine can be got under way within a reasonably short time by lighting the fire in the generator and the consumption of coal ceases as soon as the work is done.

Mechanical engineers are now giving much attention to the economical results that be developed in the working of gas, gasoline, and oil engines for higher powers, from petroleum and its products and from producer and other cheap gases.

It is now a question of how to adapt and design these engines to derive a wider range of usefulness and economy since steam from an economical standpoint, for small and intermediate power, is being left far behind in the race for supremacy. A case is cited in England where recently the pumping was done by steam-driven pumps, the coal bill amounting to about $5,000 per annum, gas engines and suction plants were substituted, and the total cost of coal per year since has been $750. The time is past when an engineer can afford to accept steam as the source of power without consideration of other means. Gasoline or oil engines, electric motors, where current can be cheaply obtained, and gas producer plants, all demand consideration with a justification, in each case, depending on local conditions. With the present price of gasoline in Canada this source of energy can hardly be considered in any but small plants. Crude oil engines, at the present price of this fuel, have much to commend them for small installations, but cannot usually compete in economy with plants of other types. Notwithstanding that the operation of producer plants is much simpler than steam, it seems to be difficult at present to obtain attendants who appreciate the requirements and are in sympathy with this type of apparatus.

MANAGEMENT OF FILTER PLANTS.

Samples of water from different sources when subjected to careful analysis each have their own peculiarities. A careful study of each case in all its phases is therefore essential before the work of filtration is commenced. Sand is the actual filtering medium in nearly all plants. There is the slow sand filter where the water flows on the beds in its natural state; and the more rapid type where the water has had a previous preparation. In each case the sand is depended on for the actual work of filtering.

The usefulness and safety of a mechanical filter plant depends almost entirely upon how it is operated. The condition in which the filtering material is kept will govern the efficiency of any form of plant. It must therefore be operated by an experienced man since the great question of life and health depend upon his efficiency.

Carelessness in the management of a plant will produce water quite as bad as the raw water itself and in possible cases even worse, since foul filter beds may become a more excellent breeding ground for bacteria than the raw water itself.

The manager of a filter plant should be well trained and able promptly to meet rapidly varying conditions which affect the quality of effluent. This class of waterworks engineering cannot be governed by any fixed rules. One condition of water might be purified by a time method, while another would not. The operator should not only be thoroughly familiar with every detail of his plant, including the working of pumps, coagulant feeding devices, washing machinery, etc., but he should have a good working knowledge of water analysis. The ability to make these tests is almost an absolute necessity in order that he might know at all times whether the filter devices are working satisfactorily. Filtration of public water supplies is fast coming into favor, and in a great many places where the water supply is diminishing will soon be an absolute necessity.

Damages for the diversion of underground waters are claimed in a suit brought against East Orange, N.J., by Mr. Frank W. Meeker, a farmer of Livingston, N.J. Mr. Meeker asks for $10,000 damages on account of the alleged drying up of springs on his farm subsequent to the use by the East Orange waterworks of twenty wells sunk by the department at White Oak Ridge, in the township of Milburn, about one-quarter mile from his place. The springs were used for watering cattle and cooling milk. He also claims that the yield of certain hay fields has been reduced in the ratio of 20 to 6. It is said that this is the first lawsuit of the kind brought in the State of New Jersey.—Engineering News.

NIAGARA POWER RUNS TORONTO PUMPS.

The pumps in connection with the sewage disposal plant at the Woodbine, Toronto, were run by electric power from Niagara on Thursday morning last, and the pumps worked satisfactorily. This is the first civic plant to be operated by Niagara power.

CATALOGUES AND CIRCULARS.

Fire Brick.—The Garden City Sand Co., Security Building, Chicago. This pamphlet shows fire brick and tile for almost every purpose; shaped brick is given special attention. 4¾ x 7, pp. 28.

Hoisting Engines—Allis-Chalmers-Bullock, Limited, Montreal. This company's bulletin, No. 201, is devoted to "Lidgerwood" hoisting engines for mining purposes. The bulletin deals with its subject very exhaustively, 8 x 11, pp. 20.

Friction Clutches, etc.—David Bridge & Co., Engineers, Castleton Iron Works, Castleton, Manchester. In a well gotten up catalogue, Messrs. Bridge present friction clutches, shafting, gearing, and hauling installations. A pamphlet from the same firm is descriptive of India-Rubber and Gutta Percha Machinery.

Calendars.—A very useful as well as ornamented calendar has been received from the Joseph Dixon Co., Jersey City, N.J. As well as the current month each leaf contains the past and coming months. A large colored picture of the "City Investing Building," in New York, is shown on the card upon which the calendar is mounted.

Generator Valves.—The Lunkenheimer Co., Cincinnati, Ohio. A booklet illustrating and describing several types of generator valves, 3½ x 6, pp. 24.

Railroad Shop Equipment.—Westinghouse Electric and Manufacturing Co., Pittsburg, Pa. This pamphlet describes electrical equipment at the Hornell shops of the Erie Railroad. 6 x 9, pp. 23.

Electric Lamps.—National electric Lamp Association, Cleveland, Ohio. Six bulletins have been issued by the company, describing as many types of incandescent lamps, 6 x 9.

Harvesting Machinery.—The Robt. Bell Engine and Thresher Co., Seaforth, Ont. Traction engines and threshers are shown in a very fine catalogue by this company, 5½ x 9½, pp. 88.

Electric Mine Locomotives.—The Jeffrey Mfg. Co., Columbus, Ohio. Bulletin No. 12 gives instructions for the care of these locomotives in service, 8 x 10, pp. 80.

Electric Fans.—The Canadian General Electric Co., of Toronto, have been appointed Canadian agents for the "Tuerk" alternating current ceiling fans, and they are sending out the Hunter Fan & Motor Co.'s fine catalogue, descriptive of same, 7½ x 9¼, pp. 24.

Drills.—The Knecht Bros. Co., Cincinnati, Ohio. "More Holes for Less Money" is the title of a pamphlet describing the drill manufactured by this company. 3½ x 5¾, pp. 14.

Storage Batteries.—The Westinghouse Machine Co., East Pittsburgh, Pa. Storage batteries for every kind of service are described and beautifully illustrated in a fifty page catalogue. 4½ x 6.

Wood Pipe.—The Dominion Wood Pipe Company, New Westminster, British Columbia, have issued a booklet giving certain facts pertaining to wood pipe in general, and recent improvements, 3 x 7, pp. 29.

Machinery.—C. W. Hunt Co., West New Brighton, N.Y. Pamphlet No. 073 sets forth coal handling machinery, electric hoists, automatic railways, etc. 3¼ x 6, pp. 31.

Transporting Machinery.—The Temperley Transporter Co., 72 Bishopgate St. Within, London, E.C., publish a 122 page well illustrated catalogue containing much valuable information on transporting machinery. It contains 50 half-tone page plates and numerous half-tones and line cuts of transporters working in different capacities. Size 8 x 10½.

Magneto Switchboards.—The Dean Electric Company, Elyria, Ohio. Catalogue No. 104 contains much valuable information on telephone switchboards of every required form and accessories. It is a 103-page catalogue, containing 124 illustrations. Size, 8 x 10.

American Mining Congress.—The report of the proceedings of the Ninth Annual Session of the American Mining Congress, held in Denver, Colorado, October 16th to 19th, 1906, is to hand. It contains a complete list of the members, and photographs of the officers. The proceedings are given verbatim, and the papers read are printed in full. Denver, Col.: The American Mining Congress; 6 x 9, pp. 272.

WINNIPEG'S WATER SUPPLY.

Winnipeg is endeavouring to secure an adequate supply of pure water, and with this end in view four consulting engineers will make a report on the subject. The engineers that have been appointed for this purpose are G. S. Whipple, and James H. Fuertes, of New York, R. S. Lea, of Montreal, and J. E. Schwitzer, of Winnipeg. The four possible sources of supply, each of which will be thoroughly investigated, are East Shoal Lake, Winnipeg River, Red River, and the present well system. Shoal Lake is an arm of Lake of the Woods, according to preliminary surveys it is understood that a gravity system from this point would be practicable. In the case of the Winnipeg River pumps would have to be used, and it is thought this proposition will not be considered on account of the heavy expense of maintenance. The Red River scheme is one of filtration and sedimentation, and it is the general opinion that the artesian well system will not be considered.

The Shoal Lake and Red River schemes are the most likely, and the cost of installation will be the main factor in deciding as to which of these two systems is to be used. The plant will be designed with a view to supplying 500,000 inhabitants with water.

A RECORD WATER CONSUMPTION.

During the week ending June 24th Montreal's consumption of water exceeded all records, the total amount being 255,489,000 gallons, a daily average of 36,498,428 gallons. During the same period last year the consumption was only 215,842,000 gallons.

The consumption recorded is the highest in the history of the plant.

The municipally-owned waterworks system of Bracebridge, Ont., since its establishment about twelve years ago has cost about $35,000. There are about 500 services, and after paying debentures and all expenses the revenue for 1906 amounted to $1,023. The source of supply is springs, the water from which is carried into a reservoir in the town by gravitation, and then distributed by pumping direct on the mains. The town has an abundance of pure spring water, but for fire purposes the river is resorted to, and an unlimited quantity of water is always available. The fire pressure is about 90 pounds on the main business street, with a 42 hydrant service.

To evaporate one cubic foot of water requires the consumption of 7½ pounds of ordinary coal, or about 1 pound of coal to 1 gallon of water.

SPECIAL FIRE PROTECTION SERVICE.

By Albert H. Wehr.

The prohibition of the Fire Underwriters' Association against ordinary water meters on private fire protection services, and the excessive cost of the recently devised fire service meters which neither our company nor our consumers, care to pay, has caused us to devise a set of Rules and Regulations covering special services of this character, which we have found to be satisfactory to us and acceptable to our consumers.

We require every applicant for special fire protection service to enter into an agreement with us as per the form following, and also to furnish us with a bond, with some responsible and reliable bonding company as surety, a copy of the form of this bond being also appended. The rules and regulations embodied in the form of the agreement are modeled largely upon those of the Baltimore City Water Department, with such modifications and additions as are deemed reasonable and proper in the case of a private waterworks.

This agreement, made this ....(1)........day of ....(2)......., in the year nineteen hundred and....... (3)....... between ....(4)....... (hereinafter called the "Owner") party of the first part, and **The Baltimore County Water and Electric Company, of Baltimore County,** (hereinafter called the "Company") party of the second part, **Witnesseth:**

Whereas, the Owner is about to install, in ......(5)...... ......(6)....... building, situate ....(7)............... .... a Fire Protection ......(8)........ System, and is desirous that the company furnish the water supply and service pipe for said system from its mains;

And Whereas, the company is willing to furnish the necessary water supply and connection therefor, to said system, upon the terms and conditions set forth in the following:—

RULES GOVERNING SPECIAL WATER SUPPLIES FOR FIRE PROTECTION.

Installation of Service and Charges:—

All fire services will be installed by the company, which will ascertain the best location for same, and lay the pipe from the street main to a point just inside the wall of the building, or within the building line of open yards, where buildings are set back from the building line. The owner will be charged with the exact cost of labor and materials used in the work of installing the service, with an addition of ten per cent. to cover the cost of superintendence and inspection. Payments for installing the service shall be made as follows: Simultaneously with the execution of the agreement for the Fire Protection Service, by the owner, such owner shall pay in advance, to the company, an amount, which shall be credited against the total cost of installing the service as above set out, based upon the estimated length of the fire service pipe to be installed by the company, and upon the size of such pipe, at the following rates:—

For 4-inch service pipe,	40c.	per lineal foot,
For 6-inch service pipe,	60c.	per lineal foot,
For 8-inch service pipe,	90c.	per lineal foot,
For 10-inch service pipe,	$1.25	per lineal foot.

and immediately upon the completion of the work of installing said service pipe and the rendition of the bill therefor, the balance of the cost to be charged as above shall be due and payable.

All repairs to the service pipe between the street main and the building or building line, as the case may be, shall be done by the company at the expense of the owner.

The annual charges for this service, payable in advance, as of January 1st, and every year, shall be as follows:—

For 4-inch service pipe	$50.00
For 6-inch service pipe	50.00
For 8-inch service pipe	100.00
For 10-inch service pipe	150.00

Size of Service Pipe.

In all cases the company shall decide the size of the service pipe required, which shall be determined by the size of the street main, the available pressure on the main, and the nature and capacity of the fire protection equipment within the building. In all cases where underwriters' pumps are to be installed, a suction pipe of sufficient internal area to deliver a quantity of water equal to the full rated capacity of the pipe will be allowed, and no enlargement of said suction pipe inside the premises will be permitted. If, however, this service pipe is run to a surge tank placed in close proximity to the pump, the full size of suction which the pump calls for may be run from the pump to the tank.

Number of Services:

One service only will be allowed to any one building or premises, unless in the opinion of the company more than one is absolutely necessary for the proper protection of the premises. All fire protection equipment connected to the company's service shall be confined within the building or on the premises named in the application, and where two or more connections are made for one building or premises, they shall be kept separated, unless special permission is obtained from the company to connect the same in a manner to be approved by it.

Use of Fire Services.

No water shall be drawn from the fire service pipes for any purpose whatever, except for the extinguishment of fire, and no connection shall be made between the fire service pipe system and the regular water supply to the premises, and the valves on hose outlets, drain cocks, etc., placed on the pipe system shall be of a style that can be sealed by the company and when any such valve or cock is opened, the owner or occupant of the premises shall notify the company at once, so that the same can be resealed. This paragraph is not to be construed as prohibiting a reasonable use of water for draining of a system to prevent freezing, or other reasonable use in connection with proper fire protection, but does not permit of the use of water through the system for fire drills, except with the consent of the company first had and obtained by the owner in every instance, when such drill is to be had. Whenever a fire service system is to be tested under the regulations of the fire insurance underwriters, the owner must notify the company of such proposed test, naming the day and hour when the same is intended to be made, so that, if desired, the company may have an inspector present during the test.

Contamination of Water Supply.

Any fire protection system supplied with water from the company's service shall be supplied exclusively with such water, and no connection will be allowed with any other system drawing its supply from any other source whereby the company's water supply may be contaminated by the failure to close valves, or leaking check valves, etc., and no auxiliary or secondary suction pipe to any underwriter's pump taking water from the harbor, streams, or other source whatever will be permitted. Any fire protection system using water from the harbor, streams or other source than the company's service, shall be kept separate from any such system supplied from the company's service.

Inspections.

All fire services shall be subject to inspection by the company from time to time, and the owner or tenant shall give the inspectors all reasonable facilities for making the inspections, and any information concerning the same that the inspector or the Company may require. Care will always be taken that inspections will be made with as little inconvenience to the owner or occupant as possible.

Penalties.

In any case when the owner or occupant of any premises is found to be using water from a fire service for other purposes than fire protection, or fail to comply with any of the aforegoing Rules not hereafter specifically excepted, the water shall be shut off from the same at once, and the owner shall thereupon immediately be and become liable to the company for the sum of five hundred dollars ($500), as compensation to the company for any and all damages sustained by it for such wrongful use of its water supply, or for failure to comply with such Rules. In such event the fire service shall be reopened only after such sum of five hundred dollars shall have been paid, and the cause of complaint entirely removed. A second violation of this rule will again make the owner immediately liable to the company for the second sum of five hundred dollars ($500), as in the event of a first violation, and further will be sufficient cause for cutting the service off at the main, and refusing to re-connect the same while the offender occupies the premises.

Failure to pay the balance of the cost of installing the fire service, or any subsequent repairs thereto, or the annual charge for the maintenance of the service, as hereinbefore mentioned, within thirty (30) days after the rendition of the bill therefor, will be sufficient cause for turning off the water from the supply without further notice.

Guarantees.

The company in no manner guarantees to furnish a proper quantity of water through the fire protection service for fire protection, nor does it undertake to guarantee anything relative to any service, but it will make every effort to maintain the efficiency of its service under all conditions. The company will not be responsible in any manner for failure of its water supply during a fire, or at any other time.

Discontinuance of Service.

Any fire service may be discontinued by either the owner or the company, at any time, upon thirty (30) days' notice, in writing, sent to the other party to its last known address, through the regular mails or otherwise.

Agreement and Bond.

A properly drawn agreement covering any fire protection service, embodying all of the above Rules, which shall be a part of said agreement, shall be prepared and executed by both the owner and the company, and in addition to this agreement the owner shall file with the company a satisfactory bond, in the penalty of one thousand dollars ($1,000), conditioned upon the faithful performance of said agreement, with all its conditions as above set forth, and shall continue said bond in force during the continuance of said agreement.

And Whereas, the owner has applied for an .... (9) ....inch fire service connection, to the installation of which size or service the company has assented, but in no respect has applied for, or been granted, any special connections, uses or privileges relative to said fire service, to which special connections, uses or privileges, reference is made in the aforegoing "Rules and Regulations," except as specifically set forth as follows: ....(10).........

Now, Therefore, This Agreement Witnesseth, That for and in consideration of the premises, and of the payment annually of the sum of ....(11)........ Dollars, to be made by the owner of the company, as is provided in the "Rules and Regulations" aforesaid, the said company, upon its part doth hereby covenant and agree to install, at the earliest date possible, and to thereafter maintain, the fire service connection aforesaid, upon the terms and conditions set forth in the aforegoing "Rules and Regulations."

And the owner, upon ....(12)........ part, doth hereby covenant and agree to make the payments aforesaid, as well as all other payments mentioned to be made in the "Rules and Regulations" aforesaid, as and when the same are, by said "Rules and Regulations" required to be made, and doth further covenant and agree to comply with and be bound by all the terms, conditions and stipulations set forth in said "Rules and Regulations," and in this Agreement.

.... (13) ....

As Witness the name of the party of the first part, hereunto subscribed by ....(14)........ and the name of the party of the second part, hereunto subscribed is .... President, with its corporate seal affixed, duly attested by its Secretary.

TEST:

....

....

The Baltimore County Water and Electric Company of Baltimore County,

By ....

President.

Attest:

....

Secretary.

Note:—Fill in blanks to properly meet conditions, as follows:

(1) Date.
(2) Month.
(3) Year.
(4) Full and proper name of applicant.
(5) His, their, or its, as the case may be.
(6) Description of building, as "Factory," etc.
(7) Accurate description of location of building.
(8) Style of system, whether "Sprinkler" or "Standpipe."
(9) Size of Service pipe to the installed.
(10) Set forth fully any and all special connections, uses or privileges, if any, which have been allowed, contrary to the Rules and Regulations.
(11) The amount of the annual charge, as per size of service.
(12) His, their or its.
(13) Here insert any other agreement relative to the service or the ownership of the service pipe, etc., which should properly be included in this agreement.
(14) If applicant is an individual, strike out "hereunto subscribed by"; if a partnership, insert name of partner signing; if a corporation, insert "its President, with its corporate seal affixed, duly attested by its secretary."

(Form of Bond.)

Know All Men by These Presents, That......(name of applicant)......(hereinafter called the Principal), and the ......(name of Surety)......Company, a corporation created and existing under the laws of the State of......, and whose principal office is located in......City, State of......, (hereinafter called the Surety), are held and firmly bound unto **The Baltimore County Water and Electric Company of Baltimore County,** (hereinafter called the Obligee), in the full and just sum of **One Thousand Dollars ($1,000)** lawful money of the United States, to be paid to the said Obligee, for which payment, well and truly to be made, the said Principal binds ......self, ...(personal representatives and assigns, if individual of firm, and successors and assigns, if a corporation)......and the said Surety binds itself, its successors and assigns, jointly and severally, firmly by these presents.

Signed and Sealed this......day of......,**A.D.**

The Condition of this Obligation is such, that whereas the said Principal has executed and entered into a certain agreement with the said Obligee, dated the.....day of..... 190.., for Special Water Supply for Fire Protection, in said agreement described, a copy of which agreement is hereto annexed.

Now, if the said Principal shall well and truly perform and observe said agreement and fulfil and perform all and every the covenants and conditions mentioned in said agreement, on......part to be fulfilled and performed; and shall keep the said Obligee harmless and indemnified from and against all demands, judgments, claims, liens, costs, and fees of every description incurred in suits or otherwise, then this obligation shall be void, otherwise the same shall remain in full force and virtue.

Provided, However, that in the event of default by the Principal in the fulfilment of any of the covenants and conditions of the said agreement, the Surety shall be promptly notified thereof.

And Provided, Further, that the Surety may cancel its obligation under the terms of this bond, by giving the Principal and the Obligee thirty (30) days' written notice of its intention and desire so to do, and no liability shall attach to the Surety for any acts or omissions occuring after the expiration of said thirty days.

In Testimony Whereof, the said Principal has caused these presents to be signed and sealed (....with its corporate seal duly attested by its duly authorized officers) ..or.. (by the several members of said firm)......, and the said Surety has caused these presents to be sealed with its corporate seal, duly attached by the signature of its..President and its..Secretary, the day and year first above written.

....

....

The....................................Company,

by..

President.

Attest:

....

Secretary.

NOTE AS TO THE ACTION OF WATER UPON LEAD AND ZINC.

Dr. W. P. Mason.

Reports recording that a water contains so many parts per million of lead, zinc or other metal are common enough, but it is rare to find advance statements of what a water is capable of doing in the way of dissolving metals should opportunity be afforded it of coming in contact with it. In other words, a client who possesses a water supply which is very desirable at its source is seldom informed of the possible damage which may result thereto by reason of its being conveyed through metallic piping.

After the pipes have been laid and the water admitted to them, record is made of the result as to metallic solvency, but little is found in the nature of a prophecy antidating the outlay of capital, which prophecy, had it been uttered in time, might have had material bearing upon the investment. Again, if, as occurs in a few instances, the client be told that the water under examination is capable of acting upon certain metals he is not given the information in such quantitative form as will enable him to make comparisons between it and other waters with reference to this property.

It is well known that all waters do not equally possess the power to attack metals, and it is proper to ask that, granting such power to exist, how far is its exercise objectionable from a sanitary point of view, or, to state it differently, what amount of metallic salts in solution may be allowed with safety?

The interesting case is given of "A water from the tail-race of a gold and silver mill which showed the presence of 350 parts of lead, 51 parts of copper and 1,666 parts of arsenic oxide per million of water. This water, which was supposed to have caused the death of a number of cattle, was so highly charged with arsenic that an ordinary drink for man or beast would contain sufficient to kill." (Utah Agr. Expt. Sta. Bull. 81, p. 199.)

Such a special instance, however, does not come within the limits of the present inquiry.

Let us consider for a moment the question of "plumbism," or lead poisoning, as it is ordinarily presented under the classification of a water-born disease.

The Massachusets State Board of Health enumerates the symptoms of lead poisoning as some or all of the following: Anaemia, constipation, indigestion, loss of appetite, thirst, metallic taste, abdominal pain, colic, "drop-wrist," blue line at margin of gums, lead in the urine. (Report of Mass. State Board of Health, 1898, XXXIII.)

Dr. Hunter, describing the effects of the epidemic at Pudsey, says: "Anaemia and debility were the most common symptoms. Patients nearly always complained that they felt as if they would sink down from weakness, and that the least exertion would make them sweat freely. The majority had the blue gum line so characteristic of lead poisoning. Colic was a common symptom. Paralysis was not common, but there were five or six cases of almost general paralysis, and in these cases 'drop-wrist' was included. The amount of lead found in the waters producing these effects varied from .01 to 1 grain or more per imperial gallon. (.143 to 14.3 per million.") (Thresh. Examination of water, page 88.)

There is some difference of opinion among the authorities as to the amounts of contained lead required to condemn a water, but all are agreed that even small quantities should be narrowly watched. Thus, the Massachusetts reports note that one-half part per million has caused serious injury. (Mass. State Board of Health, 1898. XXXII.) Haines holds that .1 grain per U. S. gallon (1.71 per million) should cause a water to be rejected (J. Fk. Inst. Nov., 1890).

Whitelegge believes that "No water should be used for drinking which contains more than one part of lead per million, and any trace, however minute, indicates danger." (Hygiene and Public Health.)

To quote Dr. Summerville in his recent paper in "Water": "Lead to the extent of .25 part per million is sufficient to condemn a potable water."

That sundry waters contain enough lead to prevent their acceptance by at least some of the standards above laid down is shown by the fact that a few years ago it was reported that sixty-three (63) cities of Massachusetts possessed public water supply which contained lead in amounts varying from 85.46 to .032 per million. In four of these cities where lead poisoning was pronounced the average amount of the metal present during ordinary day time use was one part or over per million. Occasional instances of "plumbism" were noticed in other towns, and doubtless other mild or unrecognized cases occurred elsewhere. (Mass. State Board of Health, 1898, uage 543.)

In the thirty-first annual report of the London Local Government Board (1901-02 Supplement on Lead Poisoning and Water Supply, Vol. II., page 426), peaty, moorland waters are shown to be especially plumbo-solvent, to a degree chiefly governed by the amount of acidity present, and experiments show that such acidity is due, at least in part, to acid-form bacteria residing in the peat.

For instance, the influence of acidity is shown by the action of the following moorland waters from Lancashire and Yorkshire:—

(Thresh. Examination of Water, page 186.)

Acidity of water in terms of C. C. of $\frac{N}{10}$ Na2 Co3 required to neutralize 100 C.C. of the water.	Milligrams of Pb. in 100 C. C. of the water after filtering through lead shot.
0.2	.28
.3	.25
.4	.4
.5	.66
.6	.92
.8	1.5
.9	2.4
1.1	3.2
2.2	8.6

The London report already quoted is so firm in its belief that the cause of plumbo-solvency has been located that it ventures to rate moorland waters as "safe" if they are neutral to lacmoid, and as "dangerous" if they react acid with that indicator. Attention is also called therein to the fact that moorland streams are highest in acidity during wet weather because of drainage from peaty surface sources, and less so during periods of no rain on account of their supply at such seasons coming from the flow of springs.

In this connection it may be noted that H. W. Clark observed that carbonic acid in a soft water was the main factor that caused lead to be taken into solution by the waters from Massachusetts. (Engineering News, Dec. 1, 1904.)

It is by no means new to distinguish between the "solution" of lead and that "erosion" of the metal which some waters exercise, whereby insoluble lead salts are formed with appreciable increase in the turbidity of the water.

Such classification of the action upon lead has been developed by the report of the London Local Government Board with great care.

For our purposes it will suffice to note that "erosion" does not occur in the absence of oxygen, and we are also to remember that from the sanitarian's point of view "erosion" may be fully as objectionable as "solution" if no opportunity for clarification be furnished. In fact, the former may readily be the greater evil of the two, because of its involving the possibility of the ingestion of large quantities of lead salts held in suspension.

Piping water in tubes of galvanized iron is very common, and, as zinc is often more easily attacked than lead, it is pertinent to ask if it be equally dangerous. So far as our present experience can guide us towards a correct solution of this question, the reply must be a negative one, and the following opinions are presented in support of such contention:—

In the journal of the German Society of Gas and Water Engineers for 1887, H. Bante collected statistics to show "that the use of galvanized pipes should be in no way detrimental to health."

Similar views are entertained by V. Ehumann, director of the Water Supply of Wurtemburg. (J. Fk. Inst. Nov., 1890.)

According to Thresh (Examination of Waters and Water Supplies, page 85): "There is no doubt that waters containing traces of zinc are used continuously for long periods without causing any obvious ill effects. The water supply to a small hospital with which I was connected for some years always contained a trace of zinc, probably never more than half a grain of the carbonate per imperial gallon (7.1 parts per million), but I never observed any indications of its being deleterious, although such effects were looked for."

In the Massachusetts Board of Health report for 1900, page 495, the following table is given, showing amounts of zinc in sundry public supplies, the metal having been dissolved from pipes of galvanized iron or brass during ordinary use. The results are averages, and are in part per million:—

West Berlin	18.46	Lowell	0.33
Milbury	3.08	Webster	0.28
Newton	1.25	Sheffield	8.65
Marblehead	0.85	Palmer	2.90
Grafton	0.73	Beverly	2.71
Wellesley	0.68	Fall River	0.07
Fairhaven	0.52		

The first of the above, West Berlin, drew its water through four thousand feet of galvanized iron pipes. The quantity of metal dissolved therefrom was certainly large, but appears to have produced no evil results. "As far as is known the amount of zinc present in these waters as used is not sufficient to have any effect upon the health of the consumers of the water."

"The Board has investigated the question of the presence of zinc in drinking water supplies where galvanized iron pipes are used, and, except in case of the use of some ground waters, containing very large amounts of free carbonic acid, which dissolves zinc and many other metals very freely, the amount of zinc found in ordinary water supplies, where galvanized pipes are used, is not sufficient, in the opinion of the Board to give anxiety." (Massachusetts Board of Health, 1902, XLIII.)

In a private letter of more recent date the president of the above-mentioned board says: "If there had been any harmful effects of the presence of zinc in the public drinking waters of the State that fact would have undoubtedly been brought to our attention. No statement to this effect has been made, nor has there seemed to this board reason for suspecting serious danger from this source."

As an instance of long-continued use of a water containing much zinc the case of Brisbane, Queensland, should be quoted. In that city rain water tanks built of galvanized iron are found in all the houses. The water, which is in common use, contains about 17.1 parts per million of zinc, yet no harmful effects have been observed. (Hazen. Engineering News, April 4, 1907.)

In his experience the writer has been unable to trace any evil effects due to the presence of zinc in drinking water, even when the quantity rose as high as 23 parts per million in a water which is in constant use. It might be well to add that in the particular case just cited the zinc was derived from a long stretch of galvanized iron pipes, and the amount of the metal present was subject to great and frequent fluctuations for reasons that were not apparent.

It must be admitted, however, that, even on the assumption that the presence of zinc is of no sanitary significance, its being there is nevertheless not desirable, and the probability of a water being able to dissolve it should be determined and reported upon.

What can now be said with reference to some convenient and standard method of reporting the possible action of water upon any of the common metals?

The suggestion offered is this: Let the action, whether of solution or erosion, be stated in parts per million, and let it be that of one litre of water acting upon one square decimeter of bright metal for one hour at 15 degrees Centigrade.

The mode of procedure followed by the writer is to submerge a piece of bright sheet metal, one decimeter square, in two litres of water contained in a wide-mouthed bottle. The water is occasionally given a gentle motion, and is kept at 15 degrees for one hour, after which time the metal in solution or suspension is determined. One hour is sufficient time to allow of the watching of metallic solvency, and let it be added, the limiting of the time of action to the standard point is important for the reason that the rate of action of the same water is not only variable, but the ratio of the total action during the different lengths of time is not a simple one. Thus, the quantity of metal attacked in ten hours is by no means ten times that acted upon during one hour.

In conclusion, let it be said that, although we know in a general way that softness, acidity, dissolved gases and the presence of much chloride or nitrate will tend towards metallic action, while alkalinity and hardness are rated as protective agents, yet it is far better to actually test a water with reference to its behavior towards metals than to attempt any prophecy of its action based upon analytical knowledge of what the water may contain.

Waterworks Engineer Fellowes, of Toronto, says that the engines at the main pumping station could be so arranged that one set of engines could operate them instead of the three sets now employed. The arrangement would also make room for the sixth engine, which could be placed without any difficulty. The work of rearranging the plant would cost about $100,000.

The world's record for economy and efficiency of waterworks pumping engines is held by the plant at Bissel's Point, St. Louis, Mo., built by Allis-Chalmers Co., of Milwaukee. The duty reached at the official test was 181,068,605 foot pounds. In order that engineers may know exactly how these figures were reached the company printed in bulletin form complete retails of the test. These and other bulletins containing information not usually made public, but of great value to those interested in water-works, were distributed among the members of the American Waterworks Association by Allis-Chalmers-Bullock, Limited, in a handsome souvenir cover.

LONDON'S WATER SUPPLY.

Sir Melville Beachcroft, addressing a recent meeting of the First Metropolitan Water Board, referred to the great responsibility which lay upon the committee of maintaining works which were to provide an uninterrupted supply of water to nearly 7,000,000 of people, who consumed on an average something like 225 millions of gallons a day. These works were spread over an area of over 500 square miles, and reached from Hertford in the north to Westerham in the south, from Staines in the west to Southfleet in the east. Then again, the Committee were, and always would be, engaged in the execution of new works necessitated by increasing demands for water. Vast works were in actual progress; others, which would add to the storage capacity reservoir accommodation greater than that provided by the Staines reservoirs, had recently been ordered by the Board; and yet others would be required to meet the future wants. The present storage (including the Knight and Bessborough reservoirs, which were recently opened) amounted to 8,884 million gallons, and the reservoirs about to be constructed in the Lea Valley and at Molesey, would increase this volume by nearly 50 per cent.; yet even this would only provide for the immediate future. The great problem which lay before the Board—and a problem of the first importance and urgency—was the economical and efficient provision of works to meet the future needs of the Metropolis and to secure a continuance of the present excellent supply which it enjoyed. He commended this question to the earnest and careful attention of the next Board.

Some idea of the water supply system of the great metropolis is given in a paragraph from, "Popular Mechanics."

"If all the inhabitants of the earth were gathered into one place, surrounded by a wall 10 ft. high, and the annual water supply of Greater London were poured in, the reservoir would be filled to overflowing. In other words, each man, woman and child in the world could be supplied with 50 gallons a year from the city mains, which, put end to end, would cover nearly one-quarter of the earth's equator. Or, in other words, every person in London could take a 33-gal. bath daily, besides having plenty of water for drinking and other purposes. But that is just what they certainly do not do, so where does the flood of water go? Probably, as in other great cities, into breweries, slaughter houses, factories, hydraulic elevators and other industries, besides an enormous wastage. But it has to be paid for just the same—over 16 tons of gold a year is what it costs."

MUNICIPAL.

Ontario.

It is probable that extensions will shortly be made to the Chatham waterworks system.

Sir John Carling, one of the oldest residents of London, says that water for fire-fighting purposes should be taken from the river, and the drinking water from springs.

On September 14th the ratepayers of Toronto will be asked to vote on a by-law covering the expenditure of $710,000 for a new pumping engine and other improvements to the waterworks system.

The law regarding the use of hose is to be more strictly enforced in Toronto, owing to the shortage of water during the summer months. City Engineer Rust says that indiscriminate use is made of the hose.

The net revenue for water for the Brantford waterworks for the year ending December 31, 1906, amounted to $41,445, as compared with $38,349 in 1905. The total expenditure amounted to $17,871, leaving a surplus revenue for the year of $28,994.

Manitoba.

The village of Abernethy contemplates extensive improvements during the summer, both in regard to water supply and fire protection.

The town council of Neepawa will submit a by-law to the ratepayers on July 9th to authorize the borrowing of $25,000 for the purpose of providing a water supply for fire protection.

The ratepayers of Brandon recently carried by-laws for civic improvements to the extent of $129,000, including a by-law for a $50,000 waterworks plant.

The Winnipeg Water Commission is considering the advisability of establishing a softening plant. Alexander Potter, engineer, of New York, expressed the opinion to the Mayor that a softening plant would be useless.

Sir Thomas Shaughnessy says that the two greatest problems that confront Winnipeg are the water supply and sewage systems. He stated recently: "Two problems which every great and growing city has to solve are to secure an abundant supply of pure water and to have an efficient sewerage system."

There is a movement on foot in the Winnipeg city council to delay the proposed construction of a civic power plant, the reason being given that the city cannot undertake this and the provision of a water supply at the same time, and it is held that the city is in greater need of water than of power at the present.

Saskatchewan.

A large trunk sewer is to be laid at Regina.

A concrete dam is being built at Snowdy Springs, near Moosejaw.

J. D. Whitmore, city engineer of Moosejaw, is advertising for an assistant.

The town council of Indian Head has purchased the Brassey estate, by which all the section some eight miles south of Indian Head, in which are situated the excellent springs from which the water supply is drawn, passes into the ownership of the town. The price paid was $25 per acre.

British Columbia.

The ratepayers of Victoria will vote on a by-law for $50,000 to be expended in extensions to the sewage system.

Vernon is trying to secure an adequate water supply, and John Galt, C.E., of Toronto, is making investigations.

The municipalities of Burnaby, South Vancouver, and Richmond are considering the advisability of putting in a joint water supply for the three districts with an expert. The approximate cost of the installation has been placed at $160,000 by Col. Tracy. A resolution was passed that each council would put a by-law before its ratepayers to enable each municipality to borrow $100,000. It was pointed out that there was great necessity for a municipal water supply in all three districts.

Alberta.

During the summer the town of Raymond will install an electric lighting system and improve its water system.

PERSONAL NOTES.

Ontario.

Mr. James Crombie, of Hamilton, won the first prize at the joint convention of the International Railway Boiler Makers' Association and the Master Steam Boiler Makers' Association, held in the city of Cleveland, for his essay on "How to Heat and Drive Steel Rivets." Mr. Crombie is the foreman boilermaker at the works of the Sawyer & Massey Co.

Mr. K. L. Aitken, of Toronto, an electrolysis expert, has finished making his tests in Hamilton, and his report will be in the hands of Mr. Barrow, city engineer, shortly. He has found many places where there is a large flow of current in the pipes, but in the excavations so far made no material damage has been discovered. Advice will be given Mr. Barrow as to what precautions are to be taken in connection with the matter.

Quebec.

Mr. Thomas Britt, chief clerk of the fuel department of the Canadian Pacific Railway, has been appointed acting general fuel agent, with office in Montreal.

New Brunswick.

Mr. Robert Donaldson, who has operated a locomotive on the Fredericton branch of the C.P.R. for over a quarter of a century, has been pensioned. He will receiver $25.35 per month for the remainder of his life.

Tenders are called for by the Department of Public Works, Ottawa, F. Gelinas, secretary, as follows: (1) Until July 24th for the placing of stone and concrete blocks along south face of western breakwater at Port Colborne. (2) Until 12th for the construction of an armoury at Walkerton (advertised Canadian Engineer).

New Brunswick.

Bids will be received until July 10th by the Prince Edward Island Railway for the construction of a brick freight shed at Charlottetown, P.E.I. D. Pottinger, of Moncton, is general manager.

Nova Scotia.

The Halifax Board of Works has decided to call for new tenders for street paving contracts, owing to the fact that in the tenders already received the city was being made to pay for guarantees demanded from the companies, they having added the amount of the guarantee to the contract in all cases.

Saskatchewan.

Bids are asked until July 15th by the Department of Public Works for the erection of land titles office buildings at Yorkton and Battleford. F. J. Robinson is Deputy Minister of Public Works at Regina. (Advertised Canadian Engineer.)

Alberta.

The C.P.R. is now calling for tenders for the erection of a station in Calgary. The building will be 83 feet by 60 feet with a height of 44 feet.

CONTRACTS AWARDED.

Ontario.

The contract for the erection of a steel bridge over the Spanish River has been awarded to Dickson Bros. at $20,000.

The Royal Artificial Stone Paving Co. has been awarded the contract for constructing sidewalks at Brampton, Ont.

The contract for the construction of a pierhead in the channel at Hamilton, Ont., has been awarded to Joseph Bottle, of Thorold, Ont.

The Ontario Bridge Co. has been awarded the contract to build a steel bridge over the Aux Sable River, between Stephen and McGillivray.

The contract for the construction of a waterworks system for the town of Simcoe has been let to T. M. Cullon, of Huntsville. Willis Chipman, of Toronto, is engineer.

The Windsor Dredging Co. has been awarded the contract of dredging Toronto harbor. The Dominion Government has appropriated $50,000 to be expended this year on the work.

The contract for dredging at Victoria Harbor, Ont., has been awarded to the Owen Sound Dredge and Construction Co., Limited, of Owen Sound, Ont. Fred Gelinas is secretary, Dpartment Public Works, Ottawa, Ont.

Nova Scotia.

The contract for constructing a steel bridge at Halifax for Mackenzie & Mann on the Halifax and South Western Railway has been awarded to the Linsay Construction Co.

Manitoba.

The Hudson's Bay Company has let contracts for extensions to their store at Portage la Prairie at a cost of $20,000 or more.

Alberta.

The contract for building three bridges in the Province of Alberta has been awarded to E. D. Stimpson, of Calgary.

The Ontario Wind Engine and Pump Co. have received the order to build a 120,000 gallon steel tank, 140 feet high, in connection with the waterworks system of the town of Wetaskiwin.

Saskatchewan.

The Municipal Construction Co., of Regina, has secured the contract for installing a waterworks system at a probable cost of $50,000.

MARINE.

Ontario.

William Hogan, contractor for the construction of the new breakwater at Port Arthur, has opened offices in that city preparatory to commencing the construction of the breakwater.

British Columbia.

The first regular passenger and freight boat left White Horse for Dawson on June 5th. Every available stateroom was taken; and the like was the case with the three succeeding boats which had left up to June 12th. Development work on the mines continues, and the prospects of the season are improving steadily.

Foreign.

The British Government has appointed a committee consisting of the Right Hon. Sydney Buxton, Right Hon. David Lloyd-George, Mr. Winston Churchill, and Mr. Walter Runciman to consider the proposals for a subsidized steamship line between Great Britain and Canada.

The first of the new steamships ordered by the C.P.R. for traffic on the Great Lakes has been launched at Glasgow. The christening was done by Mrs. G. M. Bosworth, of Montreal, wife of the fourth vice-president, and the name given to the new ship was "Assiniboia"; the sister ship will be called the "Keewatin." The ships will have a speed of 16 knots, and will measure 336 feet long, 43 broad, 26.9 deep, and will have capacity for 250 first-class passengers. The "Assiniboia" will cross the Atlantic under her own steam in September, and will be cut in two at Quebec for passage through the canals.

Ontario.

Good headway is being made by the contractors for the new line of the C.P.R. from Proton to Walkerton, via Durham and Hanover. Trains are expected to be running next spring.

A new line is to be built from Toronto to Ottawa, via Kingston. The charter has not been taken out in the name of the Grand Trunk, but it is believed that they will be the owners of the line.

The Grand Trunk Pacific, M. B. O'Brien, and Z. J. Fowler, Ottawa; W. Kitchen Company, Fredericton, and J. W. McManus, Menchancock, N.B., have sent in tenders for an eight-mile section of the Transcontinental Railway near Chipman, N.B.

Manitoba.

Mayor Ashdown, of Winnipeg, is investigating the different makes of street car fenders with the object of suggesting a means to prevent the numerous fatalities that have occurred in the city. The Winnipeg Electric Street Railway Company is also engaged upon a study of the problem, and is bringing up from Toronto a number of the Jenkins fenders, with which they will experiment.

NEW BUILDINGS.

Saskatchewan.

Town hall plans have been approved by the Rosthern council, and work is to be proceeded with at once. Nobles & Anderson, of Prince Albert, are the architects.

British Columbia.

A normal school is to be built in Vancouver. F. C. Gamble, Public Works Engineer, Victoria.

The Pittsburgh Filter Manufacturing Co., Pittsburgh, Pa., publish a catalogue descriptive of plants for the filtration and softening of water. This catalogue contains much valuable information, and many very fine illustrations.

Allis-Chalmers-Bullock, Limited, of Montreal, prepared a special souvenir bulletin in connection with the Waterworks Convention. It contains records of tests of some of the largest pumping engines ever built, one of which has a capacity of 30,000,000 gallons per 24 hours. The bulletin contains many very fine illustrations.

It is sometimes possible to advance by making strategic movements to the rear—but not often. Mr. Parsons, the outside engineer employed by the Toronto City Council to advise as to the best method of dealing with the trinity of problems which afflict transportation along the waterfront is against elevated railroad tracks and a dead-end station, upon which the Board of Trade experts are agreed. The Board of Control and the Board of Trade are, apparently, on the edge of a controversy, in which, curiously enough, the city's representatives are on the side of the railways. It would be delightful to support so charming and rare a prospect; but the Board of Trade advice, which is in keeping with the proposals made in 1889 by Mr. Wellington, perhaps the most eminent engineer of his day, seems to be much more worthy of endorsation. The main objection of Mr. Parsons to a viaduct seems to be that it would supply only four tracks, which presently would be inadequate.

MANAGER AND CONTRACTORS' ENGINEER wants position end of July. Reinforced concrete and general building. Varied experience on large works. Future possible interest desirable.

Address Box 5,
Canadian Engineer.

INDUSTRIAL

Ontario.

The Grand Trunk Railway contemplates the extension of its shops at London at an estimated cost of $50,000. Jos. Hobson, Montreal, Que., is Chief Engineer.

The new factory of the Gilson Manufacturing Co., Limited, at Guelph is now ready to start operations. The plant is up-to-date and fully equipped with everything necessary for the economical production of the well-known "Goes Like Sixty" engines.

Conditions in the electric power houses at Niagara Falls, Ont., are being investigated by Ormond Higman, chief electrical engineer of the Canadian Inland Revenue Department in connection with the enforcement of the Dominion Act respecting the exportation of electricity.

Welland is commencing building operations on the Robertson Machinery Company's new factory. Material is arriving, and the first building is to be completed in three weeks. It will be of frame construction. The site is immediately alongside the G.T.R., and a spur will be run to the factory.

New Brunswick.

Bids are being asked for the construction of an extension from the breakwater to the shore at Petit Rocher, Gloucester county.

Manitoba.

Bids will be called by the Hon. J. H. Howden, Minister of Telephones, for the erection of a central exchange for the Government telephone system to be erected in Winnipeg.

Saskatchewan.

A compressed air system of waterworks, recently recommended the town of Yorkton, Sask., by a committee appointed by that town is now under way. Several small towns in the States with a natural situation similar to Yorkton were visited where this system is in use, and in each case it was found to be giving perfect satisfaction.

British Columbia.

Bids will soon be asked for furnishing waterpipe for Vancouver at an estimated cost of $10,000.

TRADE INQUIRIES.

The following inquiries relating to Canadian trade have been received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W.:—

Inquiry is made for names of English buyers of copper and nickel matte by a correspondent at Toronto.

A Canadian canning firm has asked to be placed in touch with English manufacturers and exporters of ingot tin.

NEW INCORPORATIONS.

Dominion.—Ethelwold Steamship Company, Montreal, $20,000; A. E. Woodworth, St. Lambert, Que.; A. Charters, H. J. Hague, S. D. Harris, Montreal; W. J. Dubois, New York, N.Y.

Vulcan Portland Cement Co., Montreal, $2,500,000; G. W. Macdougall, L. Macfarlane, C. A. Pope, A. Swindlehurst, M. Barclay, Montreal.

Canadian Logging Tool Co., Sault Ste. Marie, $15,000; $49,000; H. P. Adams, O. W. Bradley, H. J. Cassard, L. A. Latta, W. Davis, E. S. Gough, Evart, Mich.; N. W. Ely, Chicago, Ill.

The River Plate Shipping Co., Montreal, $150,000; C. A. McCollough, New York, N.Y.; W. A. Taft, Arlington, Mass.; G. I. Dewar, Ottawa; N. M. Ward, Orange, N.J.; W. McKissock, Boston, Mass.

The North American Mineral & Timber Co., Montreal, $49,000; H. P. Adams, O. W. Bradley, H. J. Cassard, W. Tees, L. A. Curran, E. Tees, Montreal; W. A. Stuart, Napierville, Que.; W. T. Curran, Winnipeg; J. A. Osborne, Fort Francis.

Ontario.—The City Gas Co., Oshawa, $40,000; W. C. Noxon, W. C. Brent, C. H. Burgess, G. E. Noxon, C. Swobey, Toronto.

Beaver Superior Silver Mines, Toronto, $3,000,000; J. F. Hollis, W. R. Bird, Toronto.

Cobalt & James Mines, $1,000,000; J. E. Day, J. Ferguson, E. O'Sullivan, Toronto.

Hanson Consolidated Silver Mines, Toronto, $1,500,000; J. F. Hollis, W. R. Bird, Toronto.

King Radiator Co., $100,000; W. P. Parker, G. Clark, J. A. McEvoy, G. Russell, Toronto.

The Master-Stein Cobalt Mining Co., Winnipeg, $1,000,000; J. R. L. Starr, J. H. Spence, Toronto.

Canadian Bessemer Ores, $100,000; T. Taylor, W. Gilchrist, G. T. Aylesworth, H. W. Shapley, Toronto.

Montreal River International Silver Mines, Toronto, $1,000,000; J. B. Holden, N. J. Lander, Toronto.

Murphy Mines, Haileybury, $1,000,000; T. W. Evans, H. D. Graham, T. H. Jessop, G. C. Legge, Haileybury.

The Cobalt Silver and Gold Claims Co., Cobalt, $40,000; D. A. Rose, R. S. Gilpin, G. T. Veale, E. Lewis, Toronto.

Algonquin Larder Lake Mining Co., Toronto, $2,500,000; J. E. Day, J. M. Ferguson, E. V. O'Sullivan, Toronto.

Cobalt Combine Silver Mines, Toronto, $1,000,000; H. D. McCormick, F. A. Lewis, D. A. Rose, E. Lewis, Toronto.

Forest City Gold Mining Co., Toronto, $1,000,000; F. E. Daggett, E. B. Ray, J. A. Daggett, W. B. Bentley, Toronto.

Dr. Orok Larder Mines, Haileybury, $750,000; T. W. Evans, H. D. Graham, N. B. Strong, G. C. Legge, Haileybury.

The Parker Car Heating Co., London, $160,000; T. Parker, J. M. McEvoy, E. R. Dawson, London; B. Parker, Detroit, Mich.

Prospect Developing & Mining Co., $1,000,000; J. O. Brown, O. Baker, W. J. Sutherland, N. Logan, J. C. Armstrong, Cobalt.

Munroe Prospecting and Developing Co., Cobalt, $200,000; C. F. Mitchell, W. R. Graham, J. I. Deadman, J. W. Mahon, Cobalt.

The Champion Mines Co., New Liskeard, $1,000,000; M. Rathschild, New Liskeard; S. P. Myers, J. L. S. Margoless, J. Etteberg, Montreal.

The McKinnon Mines, Haileybury, $1,000,000; A. McKinnon, Ottawa; W. W. Partridge, H. H. Hutchins, G. Whittaker, H. A. Hutchins, Montreal.

The Lansing Cobalt Mining Co., $400,000; D. Robson, H. N. Wilder, S. S. Riley, Lansing, Mich.; L. E. Landon, Springport, Mich.; E. H. Sellers, Detroit.

Coleman-Bucke Silver Mining Co., $1,000,000; F. X. Plaunt, J. I. MacCracken, D. C. McLaren, H. B. Villiers, V. Boisuest, W. Lennon, G. O'Keefe, Ottawa.

Manitoba.—Shipman Electrical Co., Winnipeg, $50,000; H. P. Grundy, F. M. Louthood, E. J. Russell, Winnipeg.

The Virden Manufacturing Co., Virden, $100,000; J. H. Agnew, Winnipeg; W. Whiteford, A. E. Smith, C. E. Ivens, H. Gilliard, A. W. Smith, Virden.

Winnipeg Iron and Machinery Works, Winnipeg, $60,000; L. F. H. Boesenberg, H. G. E. Boesenberg, G. Detberner, J. C. Boesenberg, E. Beveridge, Winnipeg.

The Portage la Prairie Construction Co., Portage la Prairie, $100,000; G. B. Hausser, W. Armstrong, W. Richardson, H. Armstrong, A. L. Hamilton, P. Whimster, Portage la Prairie.

The Glen Hayes Coal Mining and Development Co., Winnipeg, $1,000,000; G. A. Bull, H. V. Kobold, R. S. Armstrong, H. C. Hamelin, D. Pitblado, Winnipeg; S. L. Head, Rapid City; T. C. Bulloch, Crystal City.

TENDERS CALLED FOR

SEALED TENDERS addressed to the undersigned, and endorsed "Tenders for Walkerton Armoury," will be received at this office until Friday, July 12, 1907, inclusively, for the construction of an armoury at Walkerton, Ont., according to plans and specification to be seen on application to the caretaker of the post office at Walkerton, and at the Department of Public Works, Ottawa.

Tenders will not be considered unless made on the printed form supplied, and signed with the actual signatures of tenderers.

An accepted cheque on a chartered bank, payable to the order of the Honourable the Minister of Public Works, equal to ten per cent. of the amount of tender (10%), must accompany each tender. The cheque will be forfeited if the person tendering decline the contract or fail to complete the work contracted for, and will be returned in case of non-acceptance of tender.

The Department does not bind itself to accept the lowest or any tender.

By Order,

FRED. GELINAS,
Secretary.

Department of Public Works,
Ottawa, June 22, 1907.

Newspapers will not be paid for this advertisement if they insert it without authority from the Department.

SEALED TENDERS addressed to the undersigned, and endorsed "Tender for Port Colborne Harbor Improvements," will be received at this office until Wednesday, July 24, 1907, inclusively, for the supply and placing of stone and concrete blocks along South face of Western Breakwater at Port Colborne, Ont., according to specification to be seen at the office of Louis Coste, Esq., Resident Engineer, Port Colborne, Ont., and at the Department of Public Works, Ottawa.

Tenders will not be considered unless made on the printed form supplied, and signed with the actual signatures of tenderers.

An accepted cheque on a chartered bank payable to the order of the Honourable the Minister of Public Works, for three thousand dollars ($3,000.00) must accompany each tender. The cheque will be forfeited if the party tendering decline the contract or fail to complete the work contracted for, and will be returned in case of non-acceptance of tender.

The Department does not bind itself to accept the lowest or any tender.

By order,

FRED. GELINAS,
Secretary.

Department of Public Works,
Ottawa, June 22, 1907.

Newspapers inserting this advertisement without authority from the Department will not be paid for it.

TENDERS FOR LAND TITLES OFFICES

YORKTON AND BATTLEFORD

Sealed Tenders will be received up to 4.30 p.m. of Monday, July 15th, for the erection of Land Titles Office buildings at Yorkton and Battleford, Saskatchewan.

Each tender must be accompanied by an accepted cheque or other satisfactory deposit for the amount of $8,000 on each building.

This deposit will be forfeited if the tenderer fails to execute the contract and bond when requested and will be returned when the contract and bond is signed and the work commenced.

The deposit of unsuccessful tenderers will be returned when the contract is signed.

The right to reject any or all tenders and to waive any defects or irregularities therein is to be at the discretion of the Commissioner of Public Works.

Plans, specifications, form of tender and all information may be obtained on application to the undersigned or to Messrs. Darling & Pearson, Architects, Winnipeg.

The unauthorized insertion of this advertisement will not be paid for.

F. J. ROBINSON,

Deputy Commissioner of Public Works.

Dated at the Department of Public Works, Regina, this 28th day of June, 1907.

CITY OF WINNIPEG

Point Du Bois Hydro-Electric Development.

Tenders for Construction and Equipment

Sealed Tenders, on prescribed forms, addressed to the Chairman of the Board of Control, Winnipeg, Canada, and marked on the envelope, "Point du Bois Hydro-Electric Development, Tender for......................................" (here add the particular item or items as below), will be received at the office of the undersigned up to noon of **Tuesday, Third Day of September, 1907,** for the construction of the General Works, and for the supply and erection of the various portions of the equipment for the Hydro-Electric Works and Station at Point du Bois, for a Transmission Line between Point du Bois and Winnipeg, and for a Receiving Transformer Station in Winnipeg.

Copies of the Instructions to Bidders, Plans, Specifications and Forms of Tender may be obtained at the Power Engineers' Office, Carnegie Library Building, Winnipeg, or may be seen at the offices of Messrs. Smith, Kerry & Chace, 124-6 Confederation Life Building, Toronto.

Each tender must be accompanied by a certified cheque, payable to the order of the City Treasurer for the sum called for in the corresponding "Instructions to Bidders," which cheque will become forfeit to the Corporation in the event of the successful tenderer refusing or neglecting to sign a satisfactory contract when called upon to do so.

Individual tenders will be received for:—

*(3) Telephone System.
(4) General Works at Point du Bois.
(5) 4,000 H.P. Turbines (five).
(6) 450 H.P. Turbines (two).
(7) 3,000 K.W. Generators (five).
(8) 250 K.W. Generators (two).
(9) Induction Motors (one).
(10) Step-up Transformers (five).
(11) Generating Station, Switching and Accessory Apparatus.
(12) Generating Station, Light, Heat and Power Systems.
(13) Generating Station, Oil and Air Systems.
(14) Erection of Transmission System (75 miles).
(15) Steel Towers.
(16) High Tension Insulators.
(17) Electric Transmission Cable.
(18) Terminal Station.
(19) Step-down Transformers (five).
(20) Terminal Station, Switching and Accessory Apparatus.
(21) Terminal Station, Light, Heat and Power Systems.
(22) Terminal Station, Oil and Air Systems.
(24) Testing Transformers and Apparatus.
(25) Electric Travelling Cranes (three).
(26) Turbine Governors (seven).
(27) Auxiliary Apparatus.
(28) Repair Shops.

An alternative lump-sum tender will be received for the entire work, including all of the above-mentioned items, together with additional work and equipment necessary to install a complete working plant. As a further alternative, tenderers may include or group together one or more of the above items, providing that they have also tendered for the individual items of such group.

The Board reserves the right to reject any or all tenders, or to accept any tender which shall appear advantageous to the City of Winnipeg.

The Office of the Board of Control.

M. PETERSON,
Secretary.

Winnipeg, June 8, 1907.

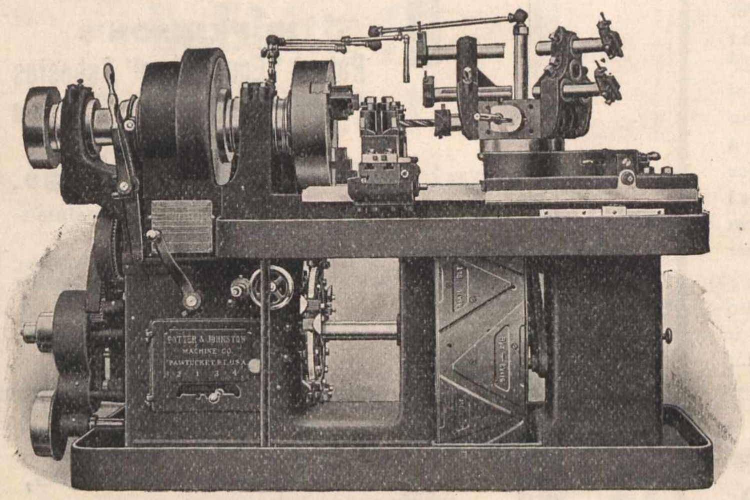
*The numbers are these of the different volumes of specifications.

AUTOMATIC PRODUCTION

FROM

Potter & Johnston

Manufacturing Automatics,



MEANS

INCREASED OUTPUT and REDUCED COSTS.

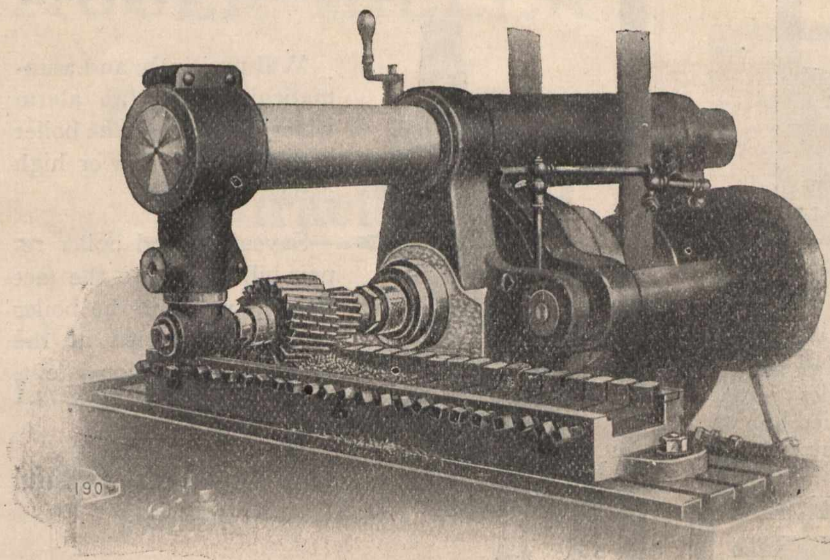
For handling castings and forgings of all varieties; also bar work of large diameter.

Machines entirely automatic in their operation, and one attendant can run from two to six machines.

Send us drawings or samples of your work for estimate of output.

Potter & Johnston Machine Co., Pawtucket, R.I., U.S.A.

REPETITION WORK



A great many shops are proving to their own satisfaction, that it no longer pays to finish small machine parts on the old-fashioned Lincoln type of miller. We can tell you of some large shops that have replaced their Lincoln pattern miller equipment with Cincinnati No. 2 Plains, and are getting out more work and better work, because these machines are more powerful and more convenient to operate. Note for example, this gray iron casting $1\frac{1}{8}''$ wide. Twenty-four of these are in a string jig and finished at one cut with a gang of cutters $4\frac{1}{2}''$ and $3\frac{1}{2}''$ diameter as shown. The total width of cut is $3\frac{3}{4}''$, depth of cut $\frac{1}{8}''$—table travel $1\frac{7}{8}''$ per minute. The finished pieces are accurate within .001, ready for assembling without additional hand work.

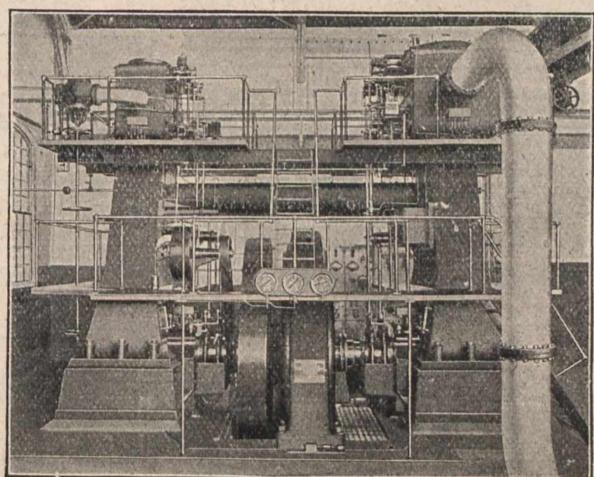
This machine finishes 24 of these pieces in 15 minutes.

Let us figure on millers for your work. WE ARE MILLING SPECIALISTS.

The Cincinnati Milling Machine Company

CINCINNATI, OHIO, U. S. A.

Canada Agents---Williams and Wilson, Montreal. H. W. Petrie, Toronto.



21 & 42 x 30 Vertical Compound Goldie Corliss Engine.

The Ontario Railway and Municipal Board has approved of an application from Newmarket validating a by-law which provides for the extension of the municipal electric light plant. A deputation consisting of T. H. Lennox, M.P.P., Mayor Smith, Chairman Moore, of the Electric Light Committee, and J. C. Hughes, town clerk, supported the application before the board.

Classified Advertiser's Directory.

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Classified Advertisers' Directory—Con'd.

FOR ALPHABETICAL INDEX SEE PAGE 3.

Contractors' Machinery
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Beatty & Sons, M., Welland, Ont.
Canada Foundry Co., Toronto, Ont.
Canadian Rand Co., Ltd., Montreal, Que.
Dartnell, E. F., 157 St. James St., Montreal, Que.
Hayward Co., 97 Cedar St., New York, U.S.A.
Hyde & Co., Francis, 31 Wellington St., Montreal,
Jeffrey Mfg. Co., Columbus, Ohio, U.S.A.
McDougall Caledonian Iron Works Co., Ltd., John, Montreal, Que.
Mussens Ltd., Montreal, Que.
Peacock Bros., Montreal, Que.

Contractors' Plant
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Canada Foundry Co., Toronto, Ont.

Controllers
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Canadian Westinghouse Co., Ltd., Hamilton, Ont.
Canadian General Electric Co., Toronto, Ont.

Converters, Rotary
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Canadian Westinghouse Co., Ltd., Hamilton, Ont.
Canadian General Electric Co., Toronto, Ont.
Peacock Brothers, Montreal, Que.
Toronto & Hamilton Electric Co., Hamilton Ont.

Converters (for Steel Castings)
Northern Engineering Works, Detroit, Mich., U.S.A.

Conveyors.
Babcock & Wilcox, Ltd., Montreal, Que.

Conveying Machinery
Babcock & Wilcox, Ltd., Montreal, Que.
Goldie & McCulloch, Ltd., Galt, Ont.
Jeffrey Mfg. Co., Columbus, Ohio, U.S.A.
Peacock Bros., Montreal, Que.
Waterous Engine Works Co., Ltd., Brantford, Ont.

Copperine.
Alonzo W. Spooner, Port Hope, Ont.

Cranes
Babcock & Wilcox, Ltd., Montreal, Que.
Canada Foundry Co., Toronto, Ont.
Canadian Rand Co., Ltd., Montreal, Que.
Dartnell, E. F., 157 St. James St., Montreal, Que.
Dominion Bridge Co., Ltd., Montreal, Que.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hayward Co., 97 Cedar St., New York, U.S.A.
Mussens Ltd., Montreal, Que.
Northern Engineering Works, Detroit, Mich., U.S.A.
Peacock Bros., Montreal, Que.
Smart-Turner Machine Co., Ltd., Hamilton, Ont.
Yale & Towne Mfg. Co., New York, N.Y.,

Crucibles
Dixon Crucible Co., Joseph, Jersey City, U.S.A.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Crushers, Rock and Ore
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Canada Foundry Co., Toronto, Ont.
Peacock Brothers, Montreal, Que.
Waterous Engine Works Co., Ltd., Brantford, Ont.

Cupolas
Hamilton Facing Mill Co., Hamilton, Ont.
Mussens Company Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich., U.S.A.
Smith Foundry Supply Co., J. D., Cleveland, Ohio, U.S.A.

Cutters, Milling
Morse Twist Drill & Machine Co., New Bedford, Mass., U.S.A.

Damper, Regulators
Babcock & Wilcox, Ltd., Montreal, Que.
Mason Regulator Co., 158 Summer St., Montreal,

Derricks
Beatty & Sons, Ltd., M., Welland, Ont.
Canada Foundry Co., Toronto, Ont.
Dartnell, E. F., 157 St. James St., Montreal, Que.
Dominion Bridge Co., Ltd., Montreal, Que.
Hayward Co., 97 Cedar St., New York, U.S.A.
Hyde & Co., Francis, 31 Wellington St., Montreal,
Mussens Ltd., Montreal, Que.
Niagara Falls Mach. & Fdry. Co., Ltd., Niagara Falls, Ont.
Smart-Turner Machine Co., Ltd., Hamilton, Ont.

Die Heads, Self Opening
Geometric Tool Co., New Haven, Conn., U.S.A.

Dies, Screw Cutting
Geometric Tool Co., New Haven, Conn., U.S.A.

Dies, Sheet Metal Working
Bliss Co., E. W., Brooklyn, N.Y., U.S.A.

Diving Apparatus
Date, John, 152-154 Craig St., Montreal, Que.
Mussens Ltd., Montreal, Que.

Drafting.
Montreal Drafting Office, Montreal, Que.

Draughting Supplies
Berger & Sons, C. L., Boston, Mass., U.S.A.
Cooke & Sons, T., Westminster, London, England.
Harrison & Co., Montreal, Que.
Lufkin Rule Co., Saginaw, Mich., U.S.A.
Peacock Brothers, Montreal, Que.
Mechanics Supply Company, Quebec, P.Q.
Stanley & Co., London, England.

Dredges
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Beatty & Sons, Ltd., M., Welland, Ont.
Canada Foundry Co., Toronto, Ont.
Hayward Co., 97 Cedar St., New York, U.S.A.
Jeffrey Mfg. Co., Columbus, Ohio, U.S.A.
McDougall Caledonian Iron Works Co., Ltd., John, Montreal, Que.
Peacock Bros., Montreal, Que.
Polson Iron Works, Ltd., Toronto, Ont.

Drills
Abbott, William, 334 St. James St., Montreal, Que.
Mechanics Supply Company, Quebec, P.Q.
Mussens Ltd., Montreal, Que.

Drills, Automatic and Hand
Mechanics Supply Company, Quebec, P.Q.
North Bros. Mfg. Co., Philadelphia, Pa., U.S.A.

Drills, Ratchet
Mechanics Supply Company, Quebce. P. Q.
Parker Co., The Chas., Meriden, Conn., U.S.A.

Drills, Rock
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Canadian Rand Co., Ltd., Montreal, Que.
Jeffrey Mfg. Co., Columbus, Ohio, U.S.A.
Peacock Brothers, Montreal, Que

Drills, Twist
Mechanics Supply Company, Quebec, P. Q.
Morse Twist Drill & Machine Co., New Bedford, Mass., U.S.A.
Mussens Limited, Montreal, Quebec, P.Q.

Drying Apparatus
Sheldons, Limited, Galt, Ont.

Dumping Cars
Canada Foundry Co., Toronto, Ont.
Jeffrey Mfg. Co., Columbus, Ohio, U.S.A.
Peacock Brothers, Montreal, Que.

Dust Separators
Sheldons, Limited, Galt, Ont.

Dynamite
Hamilton Powder Co., Hamilton, Ont.

Dynamos and Motors
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Canadian Fairbanks Co., Ltd., Montreal, Que.
Canadian General Electric Co., Toronto, Ont.
Forman, John, 248 Craig St., W., Montreal, Que.
Munderloh & Co., Montreal, Que.
Packard Electric Co., Limited, St. Catharines, Ont.
Pringle Co., Ltd., R. E. T., Montreal, Que.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Economizers.
Babcock & Wilcox, Ltd., Montreal, Que.

Educational Institutions.
School of Practical Science, Toronto, Ont.

Ejectors
Mechanics Supply Company, Quebec, P.Q.
Peacock Brothers, Montreal, Que
Penberthy Injector Co., Ltd., Windsor, Ont.

Electric Apparatus
Canadian Electric Co., Toronto, Ont.
Mechanics Supply Co, Montreal, Quebec. P.Q.
Packard Electric Co., Limited, St. Catharines, Ont.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Electrical Fixtures
Canadian General Electric Co., Toronto, Ont.
Forman, John, 248 Craig St., W., Montreal. Que.
Mechanics Supply Company, Quebec, P.Q.

Electrical Supplies
Canadian General Electric Co., Toronto, Ont.
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Century Telephone Construction Co., Buffalo, N.Y.
Forman, John, 248 Craig St., W., Montreal, Que.
Mechanics Supply Company Que., P. Q.
Munderloh & Co., Montreal, Que.
Northern Electric & Mfg. Co., Ltd., The, Montreal, Que.
Pringle Co., Ltd., R. E. T., Montreal, Que.

Elevating and Conveying Machinery
Goldie & McCulloch, Ltd., Galt, Ont.
Jeffrey Mfg. Co., Columbus, Ohio, U.S.A.
Peacock Brothers, Montreal, Que.
Waterous Engine Works Co., Ltd. Brantford, Ont.

Elevator Enclosures
Canada Foundry Co., Toronto, Ont.
Otis-Fensom Elevator Co., Ltd., Toronto, Ont.

Elevators, Foundry.
Northern Engineering Works, Detroit, Mich., U.S.A.

Elevators, Power and Hydraulic
Darling Bros., Ltd., Montreal, Que.

Elevators, Passenger and Freight
Otis-Fensom Elevator Co., Ltd., Toronto, Ont.

Engineers and Contractors
Canadian White Company, Ltd., Montreal, Que.
Haney & Miller, Home Bank Bldg., Toronto, Ont.

Engineers, Consulting
Cairnie, Lorne McD. Montery News Bldg., Montery, N.L., Mexico.
Canadian Bearings, Limited, Hamilton, Ont.
Canadian White Co., Ltd., Sovereign Bank Bldg., Montreal, Que.
Chipman, Willis, 103 Bay St., Toronto, Ont.
Connor, Clarke & Monds, 36 Toronto St., Toronto, Ont.
Fensom, C. J., Aberdeen Chambers, Toronto, Ont.
Macallum, A. F., Toronto, Ont.
Mitchell & Co., C. H., Toronto, Ont.
Oldfield & Co. A., Winnipeg, Man.
Peacock Bros., Montreal, Que.
Smart-Turner Machine Co., Ltd., Hamilton, Ont.
Smith Fdry. Supply Co., The, J. D., Cleveland, Ohio, U.S.A.
Standard Inspection Bureau, Ltd., of Canada, 23 Jordan St., Toronto, Ont.
Smith, Kerry & Chace, Toronto, Ont.

Engineers' Supplies
Garlock Packing Co., 7 Mary St., Hamilton, Ont.
Harrison & Co., Montreal, Que.
Kerr Engine Co. Limited, Walkerville, Ont.
Mechanics Supply Company, Quebec, P.Q.
Penberthy Injector Co., Limited, Windsor, Ont.

Engineering and Surveying Instruments
Cooke & Sons, T., Westminster, London, England.
Harrison & Co., Montreal, Que.
Stanley & Co., London, England.

Engines
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Belliss & Morcom, Limited, Birmingham, Eng.
Beatty & Sons, M., Welland, Ont.
Cramp & Sons, S. & E. Bldg. Co., Wm., Phila.,
Goldie & McCulloch, Ltd., Galt, Ont.
Jenckes Machine Co., Ltd., Sherbrooke, Que.
Morris Co., I. P., Beach & Ball Sts., Phila., Pa.,
Mussens Ltd., Montreal, Que.
Peacock Brothers, Montreal, Que.
Robb Engineering Co., Ltd., Amherst, N.S.
Smart-Turner Machine Co., Ltd., Hamilton, Ont.
Sheldons, Ltd., Galt, Ont.
Waterous Engine Works Co., Ltd., Brantford, Ont.

Engines, Corliss
Goldie & McCulloch, Ltd., Galt, Ont.
Hathorn, Davey & Co., Ltd., Sun Fdry., Leeds, England.
Jack Co., Watson, Bell Telephone Bldg., Montreal, Que.
Jenckes Machine Co., Ltd., Sherbrooke, Que.
Peacock Bros., Montreal, Que.
Robb Engineering Co., Ltd., Amherst, N.S.
Williams & Dadson, Wayland, Board of Trade Bldg., Montreal, Que.

Engines, High Speed Automatic.
Goldie & McCulloch, Ltd., Galt, Ont.
Waterous Engine Works Co., Ltd., Brantford, Ont.

Engines, High Speed, Open and Enclosed.
Allen Sons & Co., Ltd., W. H. Bedford, England.

Engines, Hoisting
Beatty & Sons, M., Welland, Ont.
Canada Foundry Co., Toronto
Niagara Falls Machine & Fdry. Co., Ltd., Niagara Falls, Ont.
Otis-Fensom Elevator Co., Ltd., Toronto, Ont.
Peacock Bros., Montreal, Que.
Waterous Engine Works Co., Ltd., Brantford, Ont.

Engines, Stationary, Marine and Hoisting
Goldie & McCulloch Co, Ltd., Galt, Ont.
Jenckes Machine Co., Ltd., Sherbrooke, Que.
Polson Iron Works, Ltd., Toronto, Ont.
Peacock Brothers, Montreal, Que.
Waterous Engine Works Co., Ltd., Brantford, Ont.

Engravers
Jones Engraving Co., J. L., 168 Bay St., Toronto,

Equipment and Supplies.
International Steel Co., of Canada, Ltd., Montreal, Que.

Exhaust Heads
Darling Brothers, Limited, Montreal, Que.
Sheldons, Limited, Galt, Ont.

Fans, Motor
Canadian General Electric Co., Toronto, Ont.
Canadian Westinghouse Co., Ltd., Hamilton, Ont.
Mechanics Supply Company, Quebec, P.Q.
Sheldons, Ltd., Galt, Ont.

Fans and Blowing Apparatus
Hamilton Facing Mill Co., Hamilton, Ont.
Packard Electric Co., Limited, St. Catharines, Ont.
Sheldons, Ltd., Galt, Ont.
Sirocco Engineering Co., 22 Thames St., New York, N.Y., U.S.A.

Feed Water Heaters and Purifiers
Babcock & Wilcox, Ltd., Montreal, Que.
Darling Brothers, Limited, Montreal, Que.
Peacock Brothers, Montreal Que.
Robb Engineering Co., Amherst, N. S.
Waterous Engine Works Co., Ltd., Brantford, Ont.

Files and Rasps
Canadian Fairbanks Co., Ltd., Montreal, Que.
Mechanics Supply Company, Quebec, P.Q.
Williams & Dadson, Wayland, Board of Trade Bldg., Toronto, Ont.

Filter Presses
Perrin & Co., Ltd., William R., Toronto, Ont.

Filters, Oil
Darling Brothers, Limited, Montreal, Que.

Fire Apparatus.
Waterous Engine Works Co., Ltd., Brantford Ont.

Fire Box Blocks
Hyde & Co., Francis, Montreal, Que.

Fire Brick and Clay
Dartnell, E. F., 157 St. James St., Montreal, Que.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hyde & Co., Francis, 31 Wellington St., Montreal,
Leslie & Co., A. C., Montreal, Que.

Fittings, Steam, Water, Air, Etc.
Crane Co., Chicago, Ill., U.S.A.
Mechanics Supply Co., Quebec, P.Q.
Peacock Brothers, Montreal, Que.

(Continued on Page 78.)

Classified Advertisers' Directory—Con'd.

FOR ALPHABETICAL INDEX SEE PAGE 3.

Flour Mill Machinery
Goldie & McCulloch Co., Ltd., Galt, Ont.
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Peacock Brothers. Montreal Que.

Forges
Canada Foundry Co, Toronto, Ont
Mussens Limited, Montreal, Que.
Sheldons, Limited, Galt, Ont.

Forgings and Castings
Jack & Co., Watson, Bell Telephone Bldg., Montreal, Que
McDougall Caledonian Iron Works Co., Ltd., John, Montreal, Que.
Peacock Bros., Montreal, Que.
Wilson & Co., J. C., Glenora, Ont.

Forgings, Drop
Cramp & Sons Ship & Eng. Bldg. Co., Wm., Phila., Pa., U.S.A.
Peacock Brothers, Montreal, Que.

Foundry Equipment
Northern Engineering Works, Detroit, Mich., U.S.A.

Foundry Facings
Hamilton Facing Mill Co., Hamilton, Ont.

Foundry Supplies
Dixon Crucible Co., Joseph, Jersey City, U.S.A.
Greening Wire Co., Ltd., B., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont
Hyde & Co., Francis, 31 Wellington St., Montreal, Que.
Mussens Limited, Montreal, Que.
Peacock Brothers, Montreal, Que.
Smart-Turner Machine Co., Ltd., Hamilton, Ont.
Smith Foundry Supply Co., J. D., Cleveland, Ohio, U.S.A.
Smooth-On Mfg. Co., Jersey City, N.J., U.S.A.

Furnaces, Corrugated
Jack & Co., Watson, Bell Telephone Bldg., Montreal, Que.

Gas Engine Supplies
Penberthy Injector Co., Limited.

Gas, Gasoline and Oil Engines
Canadian Westinghouse Co., Ltd., Hamilton, Ont.
Dartnell, E. F., 157 St. James St., Montreal, Que.
Richard Hornsby & Sons, Ltd., Grantham, Eng.
Peacock Brothers, Montreal, Que.
Producer Gas Co., Toronto, Ont.
Smart-Turner Machine Co., Ltd., Hamilton, Ont.
Smith Foundry Supply Co., J. D., Cleveland, Ohio, U.S.A.
Williams & Dadson, Wayland, Board of Trade Bldg., Montreal, Que.

Gas Plants, Suction
De Clercy, J., 363 Dorchester St., Montreal, Que.
Richard Hornsby & Son, Ltd., Grantham, Eng.
Peacock Bros., Montreal, Que.
Petrie, H. W., 131-145 Front St. W., Toronto.
Producer Gas Co., Toronto, Ont.

Gas Engine Specialties
Lunkenheimer Co., Cincinnati, Ohio, U.S.A.
Peacock Brothers Montreal, Que.

Gasket Tubing
Gutta Percha & Rubber Mfg. Co., Ltd., Toronto, Ont.
Mechanics Supply Company, Quebec, P.Q.

Gage Glass Washers
Gutta Percha & Rubber Mfg. Co., Ltd., Toronto, Ont.
Mechanics Supply Company, Quebec, P.Q.

Gauges
Lunkenheimer Co., Cincinnati, Ohio, U.S.A.
Mechanics Supply Company, Quebec, P.Q.
Penberthy Injector Co., Ltd., Windsor, Ont.
Peacock Brothers, Montreal, Que.

Gears and Pinions
Bliss Co., E. W., Brooklyn, N.Y., U.S.A.
Jeffrey Mfg. Co., Columbus, Ohio, U.S.A.
Peacock Brothers, Montreal, Qne.

Gears, Machine Moulded
Wilson & Co., J. C., Glenora, Ont.

Generators, Alternating and Direct Current
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Canadian General Electric Co., Toronto, Ont.
Canadian Westinghouse Co., Ltd., Hamilton, Ont.
Packard Electric Co., Limited, St. Catharines, Ont.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Governors
Darling Brothers, Limited, Montreal, Que.
Mason Regulator Co., Boston, Mass., U.S.A.
Waterous Engine Works Co., Ltd., Brantford, Ont.
Wilson & Co., J. C., Glenora, Ont

Graders, Road
Mussens Ltd., Montreal, Que

Graphite
Dixon Crucible Co., Joseph, Jersey City, U.S.A.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Paxson Co., J. W., Philadelphia, Pa., U.S.A.
Smith Foundry Supply Co., J. D., Cleveland, Ohio, U.S.A.

Grates, Shaking.
Babcock & Wilcox, Ltd., Montreal, Que.

Hammers, Drop
Bliss Co., E. W., Brooklyn, N.Y., U.S.A.

Hangers
Wilson & Co., J. C., Glenora, Ont.

Heating and Ventilating Machinery
Crane Co., Chicago, Ill., U.S.A.
Darling Brothers, Limited, Montreal, Que.
Davis Regulator Co., G. M., Chicago, Ill., U.S.A.
Peacock Bros., Montreal, Que.
Sheldons, Limited, Galt, Ont.
Sirocco Engineering Co., 22 Thames St., New York, N.Y., U.S.A.

Hoisting and Conveying Machinery
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Peacock Brothers, Montreal, Que.

Hoists
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Canada Foundry Co., Toronto, Ont.
Canadian Rand Drill Co., Sovereign Bank Bldg., Montreal, Que.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Jenckes Machine Co., Ltd., Sherbrooke, Que.
Mussens Ltd., Montreal, Que.
Northern Engineering Works, Detroit, Mich., U.S
Peacock Bros., Montreal, Que.
Williams & Dadson, Wayland, Board of Trade Bldg., Montreal, Que.
Yale & Towne Mfg. Co., New York, N.Y., U. S. A.

Hose, Wire Wound
Gutta Percha & Rubber Mfg. Co., Ltd., Toronto, Ont.
Mechanics Supply Company, Quebec, P.Q.

Hydrants
Canada Foundry Co., Toronto, Ont.
Kerr Engine Co., Ltd., Walkerville, Ont.

Hydraulic Machinery
Allis-Chalmers-Bullock, Ltd., Montreal, Que
Canada Foundry Co. Toronto, Ont.
Peacock Brothers, Montreal, Que.

Injectors
Canada Foundry Co., Toronto, Ont.
Lunkenheimer Co., Cincinnati, Ohio, U.S.A.
Mechanics Supply Company, Quebec, P.Q.
Peacock Brothers, Montreal, Que.
Penberthy Injector Co., Ltd., Windsor, Ont.

Inspections
Standard Inspection Bureau, Ltd., of Canada, 23 Jordan St., Toronto, Ont.

Iron, Bar, Etc.
Abbott, William, 334 St. James St., Montreal, Que.
Leslie & Co., A. C., Montreal, Que.

Jacks, Lifting
Mussens Ltd., Montreal, Que.

Jacks, Pneumatic
Mussens Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich, U.S.A.

Jacks, Planer
Armstrong Bros. Tool Co., Chicago, Ill., U.S.A.
Mussens Limited, Montreal, Que.

Ladles, Foundry
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Mechanics Supply Company, Quebec, P.Q.
Mussens Limited, Montreal, Que.
Northern Engineering Works, Detroit, Mich., U.S.A.
Peacock Brothers, Montreal, Que.
Smith & Coventry, Ltd., Manchester, England.
Smith Foundry Supply Co., J. D., Cleveland, Ohio, U.S.A.

Lathe Dogs, Clamp
Armstrong Bros. Tool Co., Chicago, Ill., U.S.A.

Lathe Tools
Armstrong Bros. Tool Co., Chicago, Ill., U.S.A.
Mechanics Supply Company, Quebec, P.Q.
Mussens Limited, Montreal, Que.

Lathes
Mussens Limited, Montreal, Que.
Peacock Bros., Montreal, Que.

Lathes, Automatic
Potter & Johnston Machine Co. Pawntucket, U.S.A

Locomotives, Electric
Canadian General Electric Co., Toronto, Ont.
Jeffrey Mfg. Co., Columbus, Ohio, U.S.A.

Locomotives
Canada Foundry Co., Toronto, Ont.
Canadian Westinghouse Co., Ltd., Hamilton, Ont.
Mussens Ltd., Montreal, Que.

Lubricants, Graphite
Canada Foundry Co., Toronto, Ont.
Dixon Crucible Co., Joseph, Jersey City, U.S.A.

Lubricators
Detroit Lubricator Co., Detroit, Mich., U.S.A.
Lunkenheimer Co., Cincinnati, Ohio, U.S.A.
Michigan Lubricator Co., Detroit, Mich., U.S.A.
Peacock Bros., Montreal, Que.
Penberthy Injector Co., Windsor, Ont.

Machinery Dealers
Mussens Limited, Montreal, Que.
Peacock Bros., Montreal, Que.
Polson Iron Works, Ltd., Toronto, Ont.
Smart-Turner Machine Co., Ltd., Hamilton, Ont.
Smith Foundry Supply Co., J. D., Cleveland, Ohio, U.S.A.
Williams & Dadson, Wayland, Board of Trade Bldg., Montreal, Que.

Mechanical Rubber Goods
Gutta Percha & Rubber Mfg. Co., Ltd., Toronto, Ont.
Leslie & Co., A. C., Montreal, Que.
Mechanics Supply Company, Quebec, P.Q.

Meters, Water and Oil
Buffalo Meter Co., Buffalo, N.Y., U.S.A.

Milling Cutters
Abbott Wm., Montreal, Que.

Milling Machines
Cincinnati Milling Mach. Co., Cincinnati, O., U.S.A.
Goldie & McCulloch Co, Ltd., Galt, Ont.
Mussens Limited, Montreal, Que.
Peacock Bros., Montreal, Que.
Smith & Coventry. Ltd., Manchester, England.

Milling Tools (Adjustable Hollow)
Geometric Tool Co., New Haven, Conn., U.S.A.
Peacock Brothers, Montreal, Que.

Mining Machinery
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Morris Co., I. P., Beach & Ball Sts., Phila., Pa., U.S.A.
Mussens Ltd., Montreal, Que.
Peacock Brothers, Montreal, Que.

Motors
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Canadian General Electric Co., Toronto, Ont.
Canadian Westinghouse Co., Ltd., Hamilton, Ont.
Mechanics Supply Company, Quebec, P.Q.
Mussens Limited, Montreal, Que
Toronto & Hamilton Electric Co., Hamilton, Ont.
Packard Electric Co., Limited, St. Catharines, Ont.

Motors, Induction
Canadian General Electric Co., Toronto, Ont.
Canadian Westinghouse Co., Ltd., Hamilton, Ont.
Toronto & Hamilton Electric Co., Hamilton, Ont.
Packard Electric Co., Limited, St. Catharines, Ont.

Oil Extractors
Babcock & Wilcox, Ltd., Montreal, Que.
Darling Brothers, Limited, Montreal, Que.
Mussens Limited, Montreal, Que.

Oiling Devices
Michigan Lubricator Co., Detroit, Mich., U.S.A.
Penberthy Injector Co., Limited, Windsor, Ont.

Packing House Machinery
Perrin & Co., Ltd., Wm. R., Toronto, Ont.

Packings
France Packing Company, Lacony, Philadelphia, Pa
Garlock Packing Co., Hamilton, Ont.
Gutta Percha & Rubber Mfg. Co., Ltd., Toronto,
Mechanics Supply Company, Quebec, P.Q.

Paint, Graphite
Dixon Crucible Co., Joseph, Jersey City, U.S.A.

Pans, Vacuum
Cramp & Sons Ship & Eng. Bldg. Co., Wm., Phila., Pa., U.S.A.

Patent Attorneys
Marion & Marion, New York Life Bldg., Montreal, Que.
Sheehy & Co., James J., Washington, D.C., U.S.A.
Siggers & Siggers, 918 Front St., N. W., Washington, D.C., U.S.A.

Pipe, Gas and Water
Canada Foundry Co., Toronto, Ont.
Crane Co., Chicago, Ill., U.S.A.
Gartshore-Thomson Pipe & Fdry. Co., Hamilton, Ont.
Jack & Co., Watson, Bell Telephone Bldg., Montreal, Que.
Mechanics Supply Company, Quebec, P.Q.
Peacock Bros., Montreal, Que.

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Paris is experimenting with the latest thing in pavement. They call it steel pavement, but it is really a concrete pavement re-enforced with a steel framework. The trial section of it has been laid on the Rue Saint-Martin, in front of the Conservatoire of Arts and Industries.

The metal part of the pavement is a plate of perforated steel with strong bolts of steel running through it between the perforations. Each section has some resemblance to a steel harrow, only the prongs project equally on each side, and they are square and blunt.

The plates are arranged close together on a bed of rough concrete such as is used for wood block pavement. Then a specially prepared cement is shovelled upon them in a soft condition and rammed down until it makes a solid mass, with the steel frame just levelled off evenly with the upper tips of the prongs.

The steel prongs are so close together that the shoe of every horse and every wheel of any width must rest in part on them and in part on the cement. It is expected in this way to secure a highly durable but distinctly uneven surface, one on which horses will have sure footing in all weathers, and on which they can secure the necessary purchase to pull heavy loads.

It will be superior to asphalt in ultimate economy and to wood, both in the better footing that it affords to horses, and in the fact that it will not admit of dangerous ruts developing. The sample laid cost $5.40 a square metre, a little more than a square yard, but when the work is done on a large scale it is believed the price can be cut to about $4.50. The life of such a pavement without serious repairs is estimated at ten years as a minimum.

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FOR ALPHABETICAL INDEX SEE PAGE 3.

Tapes, Steel Measuring
Lufkin Rule Co., Saginaw Mich., U.S.A.
Mechanics Supply Company, Quebec, P.Q.

Taps and Dies
Abbott, Wm., Montreal, Que.
Geometric Tool Co., New Haven, Conn., U.S.A.
Mechanics Supply Company, Quebec, P.Q.
Peacock Bros., Montreal, Que.

Telephone Supplies
Jack & Co., Watson, Montreal, Que.
Kellogg Switchboard & Supply Co., Chicago, Ill., U.S.A.
Munderloh & Co., Montreal, Que.
Northern Electric & Mfg. Co., Ltd., Montreal, Que.
Pringle Co., Ltd., R. E. T., Montreal, Que.

Testing Machines
Denison & Son, Ltd., Samuel, Hunslet Fdry., Leeds, England.
Hamilton Facing Mill Co., Hamilton, Ont.
Mussens Limited, Montreal, Que.
Peacock Brothers, Montreal, Que.

Threading Tools
Mechanics Supply Company, Quebec, P.Q.

Tool Grinders
Armstrong Bros. Tool Co., Chicago, Ill., U.S.A.
Peacock Brothers, Montreal, Que.

Tool Holders
Armstrong Bros. Tool Co., Chicago, Ill., U.S.A.

Tools, Machinists
Mechanics Supply Company, Quebec, P.Q.
Morse Twist Drill & Machine Co., New Bedford, Mass., U.S.A.
Mussens Limited, Montreal, Que.
Peacock Brothers, Montreal, Que.
Smith & Coventry, Ltd., Manchester, England.

Tools, Steel
Leslie & Co., A. C., Montreal, Que.

Track Jacks
Canada Foundry Co., Toronto, Ont.
Montreal Steel Works, Montreal, Que.
Mussens Limited, Montreal, Que.

Transformers
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Canadian General Electric Co., Toronto, Ont.
Canadian Westinghouse Co., Ltd., Hamilton, Ont.
Mechanics Supply Company, Quebec, P.Q.
Packard Electric Co., Limited, St. Catharines, Ont.
Toronto & Hamilton Electric Co., Hamilton, Ont.

Transits and Levels
Berger & Sons, C. L., 37 Williams St., Boston, Mass., U.S.A.
Peacock Brothers, Montreal, Que.

Transmission Machinery
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Canadian Westinghouse Co., Ltd., Hamilton, Ont.
Goldie & McCulloch Co, Ltd., Galt, Ont.
Mussens Limited, Montreal, Que.
Peacock Brothers, Montreal, Que.
Smith Co., S. Morgan, York, Pa., U.S.A.
Toronto & Hamilton Electric Co., Hamilton, Ont.
Waterous Engine Works Co., Ltd., Brantford, Ont.
Wilson & Co., J. C., Glenora, Ont.

Traps, Steam
Canada Foundry Co., Toronto, Ont.
Crane Co., Chicago, Ill., U.S.A.
Darling Bros., Ltd., Montreal, Que.
Davis Regulator Co., G. M., Chicago, Ill., U.S.A.
Sheldons, Limited, Galt, Ont.

Trolleys
Canadian Rand Co., Ltd., Montreal, Que.
Mussens Limited, Montreal, Que.
Yale & Towne Mfg. Co., New York, N.Y., U. S. A.

Trucks
Canada Foundry Co., Toronto, Ont.
Mussens Limited, Montreal, Que.
Sheldons, Limited, Galt, Ont.

Turbines
Allis-Chalmers-Bullock, Ltd., Montreal, Que.
Canadian Westinghouse Co., Ltd., Hamilton, Ont.
Jenckes Machine Co., Ltd., Sherbrooke, Que.
Morris Co., I. P., Beach & Ball Sts., Phila., Pa., U.S.A.
Wilson & Co., J. C., Glenora, Ont.

Tyres
Jack & Co., Watson, Montreal, Que.

Universal Cutter and Tool
Cincinnati Milling Mach. Co., Cincinnati, O., U.S.A.
Peacock Brothers, Montreal, Que.

Valve Reseating Machines
Darling Bros., Ltd., Montreal, Que.

Valves
Babcock & Wilcox, Limited, Montreal.
Canada Foundry Co., Toronto, Ont.
Davis Regulator Co., G. M., Chicago, Ill., U.S.A.
Kerr Engine Co., Ltd., Walkerville, Ont.
Mechanics Supply Company, Quebec, P.Q.
Peacock Brothers, Montreal, Que.
Sheldons, Ltd., Galt, Ont.

Valves, Hydraulic, Safety, and Reducing
Canada Foundry Co., Toronto, Ont.
Crane Co., Chicago, Ill., U.S.A.
Darling Bros., Ltd., Montreal, Que.
Davis Regulator Co., G. M., Chicago, Ill., U.S.A.
Mason Regulator Co., 158 Summer St., Boston, Mass., U.S.A.
Morris Co., I. P., Beach & Ball Sts., Phila., Pa., U.S.A.

Valves, Rubber
Gutta Percha & Rubber Mfg. Co., Ltd., Toronto, Ont.

Vaults
Goldie & McCulloch Co, Ltd., Galt, Ont.

Ventilating Apparatus, Blowers and Bellows
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Mussens Limited, Montreal, Que.
Sheldons, Limited, Galt, Ont.

Vises
Jack & Co., Watson, Montreal, Que.
Leslie & Co., A. C., Montreal, Que.
Mechanics Supply Company, Quebec, P.Q.
Mussens Limited, Montreal, Que.
Parker Co., Chas., Meriden, Conn., U.S.A.
Potter & Johnston Machine Co., Pawtucket, R.I., U.S.A.
Prentiss Vise Co., 44 Barclay St., New York, N.Y., U.S.A.

Wagons, Contractors'
Mussens Ltd., Montreal, Que

Water Columns
Lunkenheimer Co., Cincinnati, Ohio, U.S.A.
Peacock Brothers, Montreal, Que.

Water Softening Apparatus.
Babcock & Wilcox, Ltd., Montreal, Que.

Water Works Supplies
Canada Foundry Co., Toronto, Ont.
Gartshore-Thomson Pipe & Fdry. Co., Ltd., Hamilton, Ont.
Kerr Engine Co., Limited, Walkerville, Ont.
Mechanics Supply Company, Quebec, P.Q.
Peacock Brothers, Montreal, Que.

Weighbridges
Peacock Bros., Montreal, Que.

Weighers, Suspended
Denison & Son, Ltd., Samuel, Hunslet Fdry., Leeds, England.

Welding Apparatus, Pipe
Wm. Abbott, Montreal, Que.

Wheelbarrows
Hamilton Facing Mill Co., Hamilton, Ont.
Mussens Ltd., Montreal, Que.
Smith Foundry Supply Co., J. D., Cleveland, Ohio, U.S.A.

Winches
Mussens Limited, Montreal, Que.
Yale & Towne Mfg. Co., New York, N.Y., U. S. A.

Wire
Greening Wire Co., Ltd., B., Hamilton, Ont.
Wire & Cable Co., The, Montreal, Que.

Wire and Cable
Jack & Co., Watson, Montreal, Que.
Munderloh & Co., Montreal, Que.
Northern Electric Mfg. Co., Ltd., Montreal, Que.
Peacock Bros., Montreal, Que.
Pringle Co., Ltd., R. E. T., Montreal, Que.
Wire & Cable Co., The, Montreal, Que.

Wires and Cables, Insulated
Canadian General Electric Co., Toronto, Ont.
Mechanics Supply Company, Quebec, P.Q.
Phillips Electrical Works, Ltd., Eugene F., Montreal, Que.
Wire & Cable Co., The, Montreal, Que.

Wire Chains
Greening Wire Co., Ltd., B., Hamilton, Ont.

Wire Cloth
Greening Wire Co., Ltd., B., Hamilton, Ont.

Wire Rope
Greening Wire Co., Ltd., B., Hamilton, Ont.
Jack & Co., Watson, Montreal, Que.
Mechanics Supply Company, Quebec, P.Q.
Mussens Limited, Montreal, Que.
Otis-Fensom Elevator Co., Ltd., Toronto, Ont.
Peacock Bros., Montreal, Que.

Wire, Switchboard
Kellogg Switchboard & Supply Co., Chicago, Ill., U.S.A.
Wire & Cable Co., The, Montreal, Que.

Woodworking Machinery
Goldie & McCulloch Co., Ltd., Galt, Ont.
Mussens Limited, Montreal, Que.
Peacock Bros., Montreal, Que.
Waterous Engine Works Co., Ltd., Brantford, Ont.

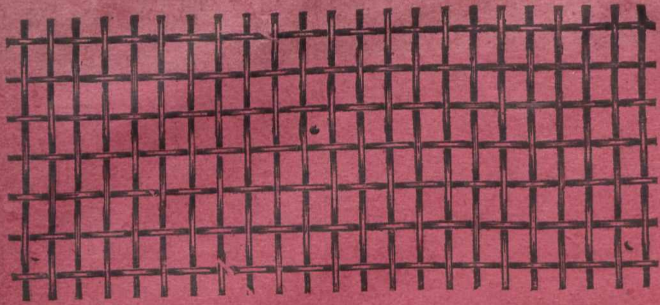
Wrought Iron Works
Canada Foundry Co., Toronto, Ont.
Waterous Engine Works Co., Ltd., Brantford, Ont.

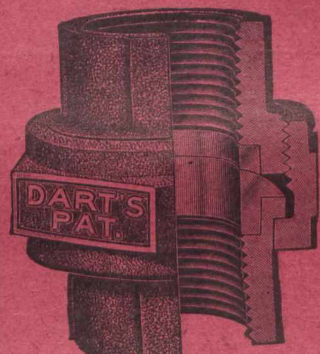
TRADE INQUIRIES.

The following inquiries have been received from the City Trade Branch of the High Commissioner's office, 73 Basinghall Street, London, E.C.:—

A manufacturers' and mill agent in Toronto seeks an agency in copper wire, both plain and insulated; also in copper and brass rods and other general metal and hardware

Canadian Patents.—A. E. Henderson, Toronto, Ont., Apparatus for Regulating the Temperature of air in Buildings; E. D. Pitt, Niagara Falls, Metallic Re-inforcements for Concrete Structures; Sydney Turner, Toronto, Ont., Friction Clutches; M. J. Haney, Toronto, Ont., Subaqueous Concrete Depositors; J. C. King, St. Catharines, Ont., Acetylene Generators; R. Balfour, Ottawa, Ont., Methods for Manufacturing Railway Ties; A. Merner, Waterloo, Ont., Interchangeable Gears for Traction Engines; W. Corbett, Smith Falls, Ont., Sheet Metal Window Sills; G. McAvity, St. John, N.B., Semaphores; W. R. Hampden, Toronto, Ont., Heaters; A. E. Caron, Ottawa, Ont., Separable Couplings; W. J. Hands, Toronto, Ont., Clutches; T. J. MacLaughlin, Ottawa, Ont., Grain Doors for Railway Freight Cars.

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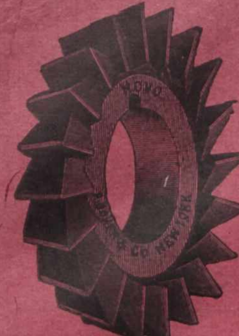

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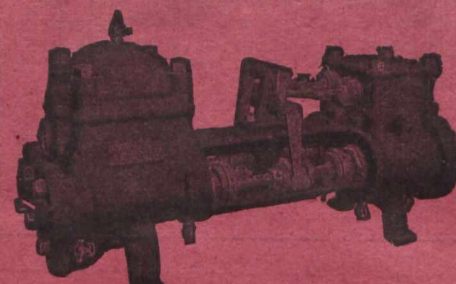

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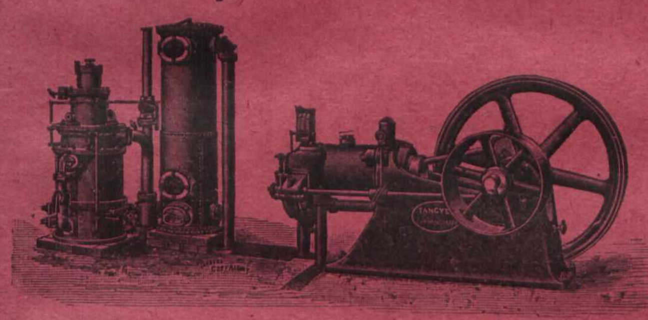
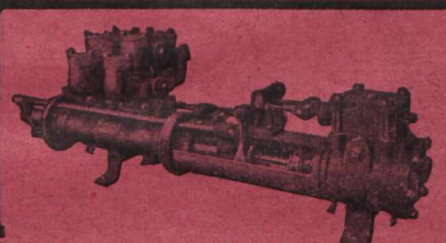


12 Plants erected last year in Canada, from 20 to 100 h.p. running on Wood, Peat, Anthracite, or Sawdust.

J. de CLERCY, C. E., 363 Dorchester St., Montreal.



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