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The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

KITCHENER SEWAGE DISPOSAL WORKS

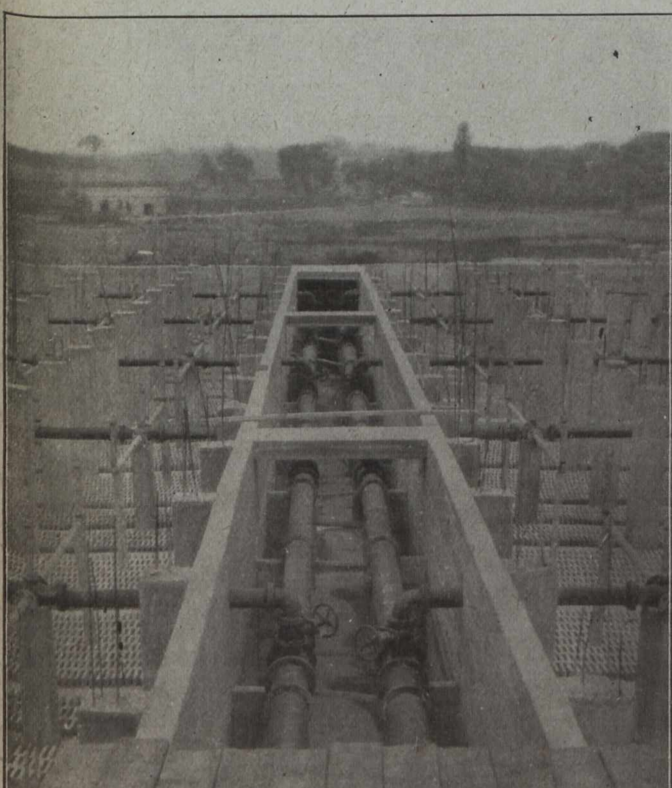
City Will Have Two Complete Disposal Systems of Different Types—New Two-Story Type Sedimentation Tanks and Spraying Filters Now Being Constructed at Cost of Approximately $75,000

By HERBERT JOHNSTON, A.M.Can.Soc.C.E.
Formerly City Engineer, Kitchener, Ontario

KITCHENER'S sewerage system was commenced in the year 1891 by the town engineer, the late H. J. Bowman. The first sewage disposal works were constructed shortly afterwards. A means of disposal was necessary at once, as the only outlet for the sewage was into a small creek with a dry-weather flow of about 1,000,000 gallons per day.

Kitchener grew rapidly from a small town with a population of 7,500 in 1891 to a city of over 19,000 in 1915. It has become a factory centre with over one hundred and twenty factories, including two large tanneries, three felt factories and three large rubber factories. The effluents from the factories make the sewage much more difficult to treat than ordinary domestic sewage.

The following table gives an idea of the increase in the amount of sewage in comparison with the increase in

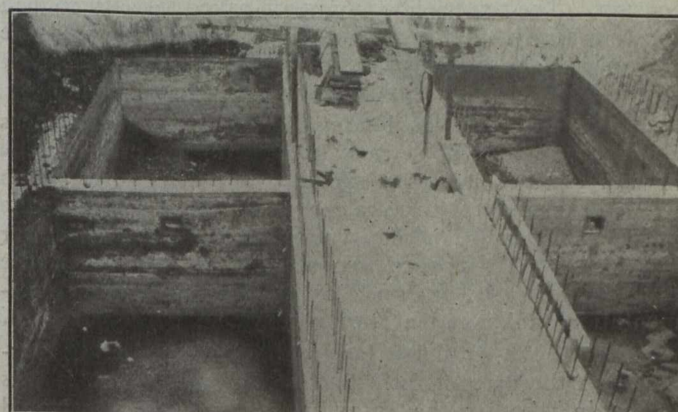


Filters, Showing Pipe Gallery.

population. The extensions in the sewer system has been much more rapid during the last few years, and the number and size of the factories have also grown rapidly.

Year.	Population.	Gals. of sewage.
1891	7,500	......
1899	9,360	225,000
1901	9,900	327,000
1903	10,400	414,000
1906	12,150	668,000
1915	19,300	1,300,000

Kitchener has adopted the separate system, and storm water is kept out of the sewers so far as possible,



Sedimentation Tanks, Showing Lower Sections.

in order to keep at a minimum the amount of sewage to be treated.

In the year 1896 the town had outgrown its first disposal works, as complaints were made by the farmers along the creek. These complaints were investigated by the provincial board of health and the creek found to be badly contaminated. As the town did not improve its disposal works these same farmers sued the town for damages, about 1900 and 1901, and they received large amounts as compensation.

In 1902 the provincial government was asked to help the town solve its sewage problem, and the government sent Dr. J. A. Amyot to investigate. The result of Dr. Amyot's report was that a new sewage plant was installed in 1904-1905 under the supervision of Wm. Mahlon Davis, who was then town engineer and the writer's partner.

This consisted of:—

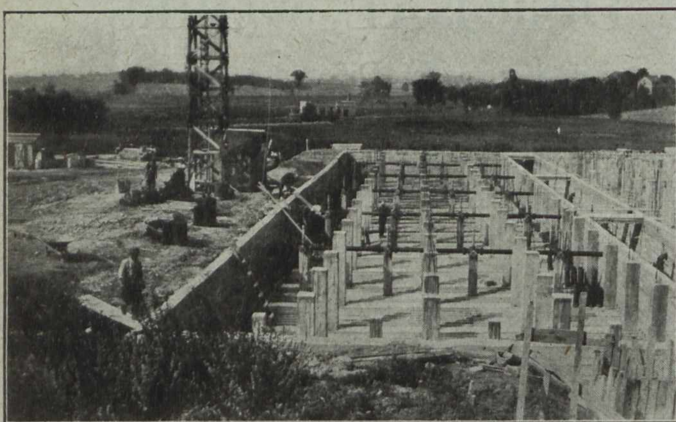
1.—Two septic tanks with a capacity of 450,000 gallons.

2.—Two storage tanks with a capacity of 450,000 gallons.

3.—Pumping station and pumping machinery, consisting of two turbine pumps with a capacity of 1,000 gallons per minute each; two 60-h.p. motors; and one sludge pump with a capacity of 500 gallons per minute.

4.—Sixteen natural sand filtration beds, containing 14 acres of filtering area.

This system gave excellent results, giving off an odorless effluent as clear and sparkling as spring water. It is still giving these results to-day.

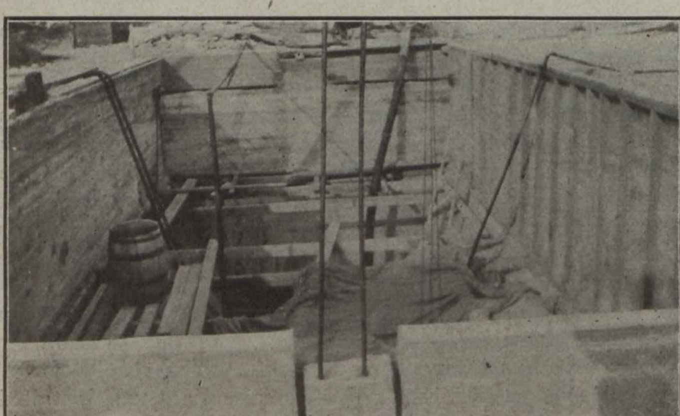


General Interior View of Filters.

In 1911 the amount of sewage was beyond its capacity and the writer, as city engineer, recommended its extension. The sewerage commission asked the city council for the money. Owing to other difficulties between the council and the commission, the work was taken over by the council and the commission was dispensed with.

Nothing more was done until 1914, when the farmers again complained of sewage going into the creek. The area of the beds was then extended to twenty acres. This was still insufficient to take care of all the sewage, so the provincial board of health was interviewed by the sewer committee. The board recommended that either the present system be extended or that deep two-story sedimentation tanks and a spraying system be constructed.

As all the available land suitable for filtering purposes on the present farm had been used, and as it was uncertain whether the spraying system of filters would give an effluent pure enough to discharge into the creek,



Sedimentation Tanks.

owing to the factory wastes in the sewage, it was decided to call in Willis Chipman, of Toronto, as consulting engineer to solve the problem.

The writer suggested extending the trunk sewer down the creek to the Grand River about two and a half miles, and adopting the deep sedimentation tank and spraying filters. This would give plenty of head to operate the plant by gravity, while at the present works all the sewage has to be pumped. Also, it would not require so many for its operation, and the effluent would be diluted by a much larger stream of water, and all trouble with the farmers would be overcome. As the present farm is partly in the city, it could be sold later at a good price. This was not adopted as the initial expense was considered too high.

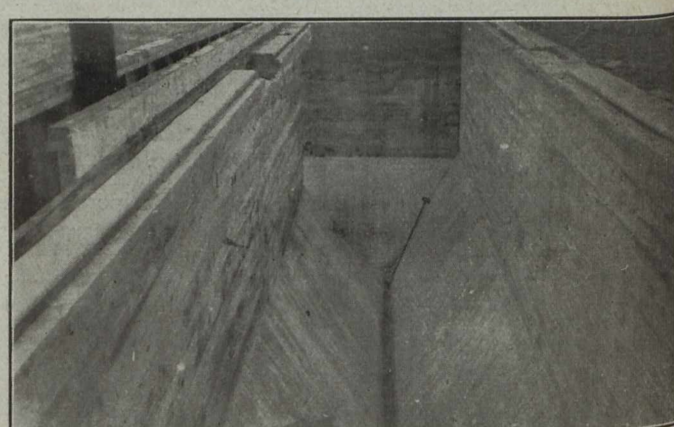
Mr. Chipman recommended:—

1.—That, as the city has two main trunk sewers, an 18-inch pipe and a 48-inch pipe, that the domestic sewage be diverted to the 18-inch sewer and the factory sewage into the 48-inch sewer and the old system of septic tanks and sand filters be used to treat the sewage from the 48-inch sewer.

2.—That sedimentation tanks of the two-story type be constructed with a capacity of 500,000 gallons per twenty-four hours for the treatment of the domestic sewage, conveyed by the 18-inch sewer.

3.—That two spraying filters be constructed to treat the effluent from these tanks.

4.—That two small humus tanks be constructed to remove the suspended matter.



Sedimentation Tanks, Showing Aprons.

5.—That sludge beds be constructed for drying the sludge from the sedimentation tanks.

6.—That a pumping plant be installed.

He gave the following reasons for recommending these:—

1.—Small area of land required and no expenditure for additional land.

2.—Extensions possible to 2,000,000 gallons per day without material changes.

3.—Better results in winter months than with beds.

4.—Sludge nuisance practically eliminated.

5.—Old works and new works together, cost of maintenance and operation therefore reduced.

6.—The new system will produce a satisfactory effluent in winter and in summer.

This report was adopted and the contract for the work was let in September, 1915. The new plant consists of the following:—

Diversion Chamber.

The diversion chamber consists of a concrete building in which are the screens and valves controlling the flow of the sewage. From the 48-inch sewer the factory sewage runs to the old septic tanks. From the 18-inch sewer the domestic sewage enters a cast-iron suction pipe which leads to the new pumps in the pumping station.

Pumping Station.

The old pumping station was built of concrete. A concrete addition has been added in which is placed the pumping machinery for the new plant.

Pumping Machinery.

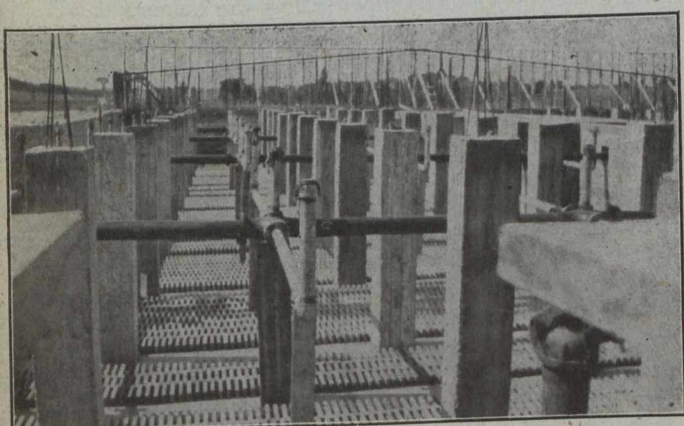
The pumping machinery consists of the following:—

1.—Two turbine pumps, each having a capacity of 500 Imperial gallons of sewage per minute against a head of 33 feet.

2.—Two electric motors with a capacity of 25 h.p. each.

3.—One Venturi meter tube with 4-inch throat designed to measure from 300 gallons to 1,200 gallons per minute. It is furnished with a register, indicator-recorder. The chart recorder dial shows the rate of flow in millions of gallons per day. The register shows the total Imperial gallons pumped and the indicator dial shows the rate of flow in gallons per minute.

4.—The switchboard consists of three panels, 65 ins. x 25 ins. x 2 ins., of black marine slate. It is furnished with two ammeters, one volt meter, one Westinghouse integrating wattmeter and a recording meter.



Interior of Filters, Showing Brick, Piers, Piping and Forms for Siphon and Dosing Chambers.

Sedimentation Tanks.

There are two sedimentation tanks of the two-story type, 55 ft. by 21 ft. x 26 ft. deep. They are placed side by side. The distributing channels and valves are so arranged that the sewage may be made to pass through only one or through both tanks at once.

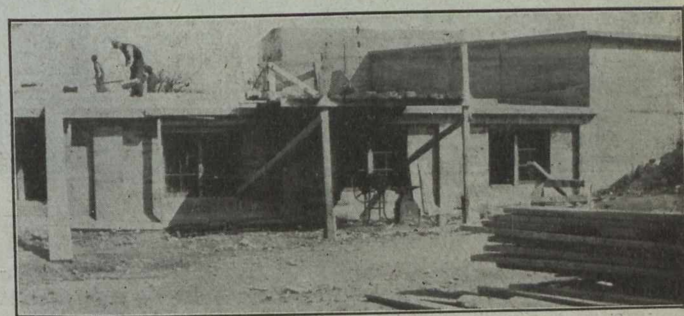
The piping is arranged so that the sludge may be drawn off by gravity. A passage is provided for raking the scum off the top. The tanks are covered with removable planks. These tanks have been completed and are now in operation.

Spraying Filters.

The spraying filters are built in two sections, each 180 ft. by 40 ft. Between the sections is a gallery 7 ft. wide, in which the supply pipes and valves are placed. Each section is fed by a syphon chamber and a dosing chamber.

A reversible screen chamber is placed between the syphon chamber and the sedimentation tanks. This is furnished with fine screens to remove any solids that may pass through the tanks.

The effluent from the filters is carried away by channels made in the concrete floor to each side and then along the outside walls to pipes leading to the humus tanks. These channels are covered with concrete bricks laid with open spaces so as to allow the effluent to pass through. These bricks support seven feet of broken stone which make up the filtering media. The lower course consists of 3-inch and 4-inch stones, one foot in depth; the next course, 2-inch and 3-inch stone, five feet in depth; and the upper course, 1-inch and 2-inch stones, one foot in depth.



Filters After Construction of Roof.

The filters will be enclosed with concrete walls with a concrete roof.

Humus Tanks.

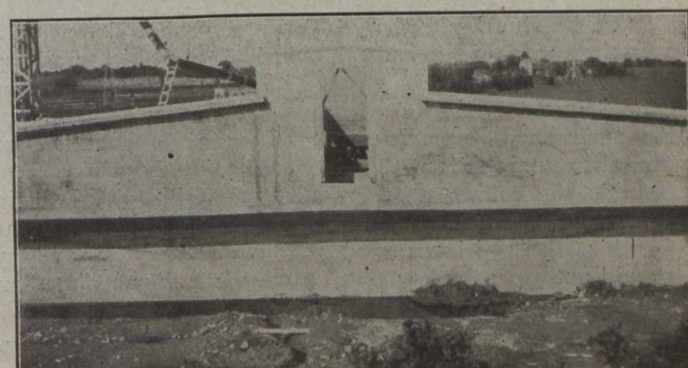
The humus tanks will be 19 ft. in diameter and 16 ft. deep. The effluent will enter through a pipe in the centre and pass out over a weir running all around the outside. From the humus tanks the effluent will pass to the creek.

Sludge Beds.

There are two sludge beds, 100 ft. by 70 ft. The natural sandy soil was graded and banks constructed. Four-inch field tile were placed under the beds 4 ft. apart, with 6-inch cross tiles 20 ft. apart. The sludge from the sedimentation tanks will be conveyed to these beds by gravity through a 12-inch cast-iron pipe.

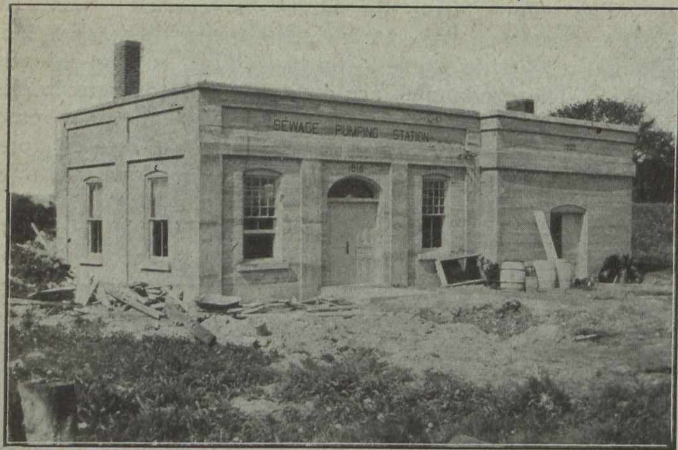
There is also a small sludge bed, 50 ft. square, to dry the sludge from the humus tanks. This sludge will be conveyed to the bed by gravity.

The cost of the whole work will amount to about $75,000, which includes about $7,000 for diverting the factory sewage to the 48-inch sewer and laying a water main to the spraying filters for flushing purposes.



End View of Filters, Covered.

G. B. Moogk, of Weston, is the contractor; Marcel Pequegnat, the resident engineer. The pumping machinery was installed by the Canadian Allis-Chalmers Co., Ltd.,



Pumping Station.

of Toronto, and it is now in operation. The whole contract was to have been completed by July 1st, 1916, but owing to the scarcity of labor it is not yet complete, but it should be in a few months.

Kitchener will now have two complete systems of sewage disposal works of different types.

C.M.A. OPPOSES NATIONALIZATION.

The Canadian Manufacturers' Association is opposed to the plan for nationalization of all Canadian railways (except the C.P.R.) as proposed by Sir Henry Drayton and Mr. Acworth. It offers as a substitute the following suggestion, carried last week at its annual meeting in Winnipeg, and sent to Ottawa:—

"(1) That immediate steps be taken to assist in overcoming the desperate need for equipment, which at present exists, by providing an ample supply of cars and locomotives and turning them over to the companies under lease or contract of purchase;

"(2) That a Board of Trustees be appointed to receive all moneys of the companies unable to meet their obligations, and to determine and supervise all expenditures of the railways to whom advances might have to be made."

C. B. Watts, of Toronto, was a strong advocate of nationalization, but he got little support.

C. B. Hamilton, also of Toronto, proposed that as a war-time measure a central board of the ablest railway men available should be created to operate the railways as efficiently as possible, as a National Service system, but his amendment was defeated. George H. Douglas, of Hamilton, pointed out that it would take about a year to provide the rolling stock required, but his plea was in vain, and the original motion carried, Colonel Thomas Cantley, the retiring president, saying that the country should not get panicky; that in ten years all the Canadian railways will be able to stand upon their own feet.

Resolutions were passed supporting a tax survey, better fire protection, and research laboratories for Canada.

The Italian output of pig iron in 1916 is returned at 454,923 tons, as against 372,909 tons in 1915 and 424,099 tons in 1913. The imports last year were 302,333 tons, as against 240,366 tons in 1915 and 221,689 tons in 1913. The output of pig iron and the home consumption thus reached record figures. The output included 7,000 tons of electric furnace iron produced at Darfo, as against 2,800 tons in 1915. The output of charcoal iron was 5,090 tons.

THE USE OF CEMENT IN BULK.

As one measure of economy, why not ditch the cement sack when possible? Cotton, paper and burlap are scarce and high-priced. Unnecessary use of any of them is wasteful, and now is the time to eliminate all waste, says the National Portland Cement Association in a recent circular.

Sacked cement is largely a habit. We got out of the habit of using barrels because the cement sack seemed a more convenient package. But hundreds of thousands of barrels of cement have been shipped in bulk, and on jobs where its handling in this form is practicable, it has been found much more convenient than sacked cement and the expense of handling is considerably lessened.

There are, however, other advantages too important to be overlooked. If you buy a sack of cement its cost includes that of the sack. You can, however, get your money back for the sack if you take such care of it that the mill can again use it for a cement container. But your best efforts to do so go wrong at times because workmen find cement sacks very convenient for protecting their boots or shoes; have found that they make good tool bags; are often the handiest things to use to cover up work. In many other ways they misuse sacks or appropriate them without compensating the owner.

Objections have been advanced against using cement in bulk. Not one can be sustained if we credit the experiences of those who have used large quantities of bulk cement. It is no longer an experiment. It is, of course, not adapted to every job, but where cement is being used directly from the car at a rate of 50 barrels a day or more, bulk cement fits the job better than sacked cement. Various users report savings varying from 5 to 10 cents per barrel on bulk cement, as compared with sacked cement. Figuring 5 cents a barrel, this would mean a saving of $10 per car on the average carload.

Cement in bulk is not likely to suffer so much damage in transit as sacked cement. Even a leaky car results in less loss to bulk cement than to sacked cement. In the first case only a little cement is damaged; in the second case, more cement and a great many sacks are damaged.

Labor employed in emptying, shaking, counting, sorting, bundling and shipping sacks is done away with on bulk shipments. This has often resulted in increasing the efficiency of the construction gang about 10 per cent. in the amount of concrete mixed and placed.

Bulk cement does away with freight charges on returned sacks and the clerical work necessary to keep track of them until they have been redeemed.

No special equipment is needed to handle bulk cement from the car to the job. The same kind of wheelbarrow that is good enough to measure aggregates can also be used to measure cement. Less dust comes from handling cement in bulk than from handling it in sacks—there are no sacks to be shaken.

Bulk cement is particularly adapted to the requirements of concrete products plants. Tight, waterproof bins are, of course, necessary, but no other special facilities. Many products plants now use bulk cement only.

On large jobs money tied up in sacks represents money that might be better in working capital. Also, experience shows that the sack losses on most jobs of any consequence vary from 5 to 10 cents per barrel.

On many jobs it is not necessary to provide storage facilities for bulk cement. It is both practical and convenient to use it directly from the car to the job as needed. If storage is required, the ideal arrangement is the overhead bin, discharging by gravity as required.

Lake of the Woods To Be Regulated For Power

International Joint Commission Presents Report — Canada to Retain Control of the Norman Dam—Main Function of Lake Recognized as Power Storage—Compensation for Land Damages

AFTER five years of investigation, the International Joint Commission has reported in favor of a high water level for the Lake of the Woods, recognizing that the dominant interests to be considered in that region are those relating to production of power and that the lake should be used as a storage reservoir to the greatest extent practicable. The Canadian authorities are to continue in control of the outlets, which are in Canadian territory, so long as the waters remain within the limits, 1,056 and 1,061 sea-level datum. But whenever the water rises above 1,061 or falls below 1,056 control shall pass to the International Joint Commission. So long as the waters of the lake are kept between the levels mentioned, only Canadian interests will be affected and, therefore, Canada will retain control. If the water rises above or falls below that range, international interests will be affected and international control will be exercised.

The conclusions and recommendations of the Commission are as follow:—

Summary of Conclusions and Recommendations.

Question 1.—The Commission answers that it is practicable and desirable to maintain the surface of the Lake of the Woods at a relatively uniform level throughout all ordinary seasons. In order to secure the most advantageous use of the waters of the lake, and of the waters flowing thereinto and therefrom, and of the shores and harbors of the lake, for the purposes stated in this question, the Commission recommends that the waters of the lake be maintained at an ordinary maximum stage of 1061.25, sea level datum, with a range from 1056 to 1062.50 representing respectively the extreme low level and the extreme high level. These extremes, however, in the opinion of the Commission, will be reached only in years of excessive drought and of excessive precipitation. The Commission also contemplates that in extreme low water years the water of the lake may be drawn below 1056, but only with its approval and upon such terms as it may impose. The Commission, as stated in its report, also considers that with proper storage and after experience has been gained in regulation, the ordinary maximum level of 1061.25 may be slightly increased.

Question 2.—The Commission answers that the ordinary maximum level of 1061.25, which it recommends, is 2.23 feet higher than the computed normal or natural level of the lake. Considering not only the low lands actually overflowed on the southern border of the Lake of the Woods or elsewhere on its border, but also the lands injuriously affected above the recommended ordinary maximum level through occasional flooding, wind effects and seepage, the Commission has concluded that flowage should be obtained up to contour 1064 sea-level datum. The Commission therefore finds that the areas, with values as at 31st December, 1915, for which flowage rights should be obtained, are as follows:—

United States, 23,968 acres, value $163,957, or say $164,000; Canada, 40,792 acres, value $80,877, or say $81,000; total value, $245,000.

The Commission estimates that the cost should not exceed $115,000 for the following:—

(1) The removal of buildings and compensation for loss of high land by erosion along the south shore of the lake in Minnesota;

(2) The necessary protection of the town of Warroad, including town lots submerged or injuriously affected;

(3) The necessary protection along water front in vicinity of Baudette, Minnesota and Rainy River, Ontario.

About $5,000 of this estimate is for protection on the Canadian side of the boundary at and near Rainy River; the balance, $110,000, is for lands and protective works in Minnesota.

Question 3.—The Commission answers that it is both possible and advisable to regulate the volume, use and outflow of the waters of the Lake of the Woods, as well as insure the adequate protection and development of all the interests involved on both sides of the boundary in the following manner:—

(1) By increasing the outflow capacity of the Lake of the Woods to 47,000 c.f.s. at a stage of 1,061 sea-level datum, costing about $175,000; and by compensating interests at the outlets and on Winnipeg River, involving about $25,000 and $30,000 respectively. The Norman dam in the Winnipeg River should be used for regulating purposes, and the cost of securing such use will have to be included. Should it be used for power as well as regulating purposes, then the necessary additional wasteway capacity will cost about $60,000.

(2) By taking advantage of the existing reservoir capacity of something over 100 billion cubic feet on Rainy Lake and the lakes immediately above Kettle Falls.

(3) By enlarging these reservoirs as soon as the demands for power warrant, so as to be able to store an additional 45 billion cubic feet—the cost of which is difficult to estimate at the present time.

(4) By international control of all dams and regulating works extending across the international boundary, also the dam at Kettle Falls in the Canadian channel, and, when the level rises above 1,061 or falls below 1,056, sea-level datum, the dams and regulating works at the outlets of the Lake of the Woods.

Problem Submitted in 1912.

The Lake of the Woods problem was submitted to the Commission on June 27th, 1912. The terms of the references, or questions, were as follows:—

(1) In order to secure the most advantageous use of the waters of the Lake of the Woods and of the waters flowing into and from the lake on each side of the boundary for domestic and sanitary purposes, for navigation and transportation purposes, for fishing purposes and for power and irrigation purposes, and also in order to secure the most advantageous use of the shores and harbors of the lake and of the waters flowing into and from the lake, it is practicable and desirable to maintain the surface of the lake during the different seasons of the year at a certain stated level, and if so at what level?

(2) If a certain stated level is recommended in answer to question No. 1, and if such level is higher than the normal or natural level of the lake, to what extent, if at all, would the lake, when maintained at such level, overflow the low lands upon its southern border, or elsewhere on its border, and what is the value of the lands which would be submerged?

(3) In what way or manner, including the construction and operation of dams or other works at the outlets and inlets of the lake, or in the waters which are directly or indirectly tributary to the lake or otherwise, is it possible and advisable to regulate the volume, use and outflow of the waters of the lake so as to maintain the level recommended in answer to question 1, and by what means or arrangement can the proper construction and operation of regulating work, or a system or method of regulation, be best secured and maintained in order to insure the adequate protection and development of all the interests involved on both sides of the boundary, with the least possible damage to all rights and interests, both public and private, which may be affected by maintaining the proposed level?

Over $100,000,000 Invested in District.

The drainage area tributary to the Lake of the Woods is 26,750 square miles, an area 5,000 square miles greater than that of the province of Nova Scotia, and exceeding that of all the New England States exclusive of Maine.

It would be difficult to overestimate the importance of the varied resources of the region, or the possibilities of their future development on both sides of the boundary. It is estimated that not less than $100,000,000 has already been invested in the district, including the lumber industry, pulp and paper mills, power plants, flour mills, fisheries, etc. The paper mills at International Falls and Fort Frances are among the largest in America, and the flour mills at Kenora have a daily output of nearly 10,000 barrels.

Over 500,000 horse-power is available on rivers flowing into and out of the Lake of the Woods. Two out of ten available power sites on the Winnipeg River alone, producing at the present time 53,000 horse-power, represent an investment of $18,000,000. This power is transmitted to the city of Winnipeg. The total capital investment directly dependent upon this Winnipeg River power is given as $170,000,000, with an annual payroll of $24,000,000 and an annual produce worth over $135,000,000. This is the result of developing only 53,000 horse-power out of a total of 420,000 on the Winnipeg River.

Through its consulting engineers, Adolph F. Meyer, of Minneapolis, and Arthur V. White, of Toronto, with the aid of well-equipped field parties, the commission carried out comprehensive surveys of the Lake of the Woods, Rainy Lake and the principal lakes tributary to the latter. It also secured a great deal of hydrological and meteorologic data. Most of this information had to be obtained at first hand, as very little was available in the government records, on either side of the boundary. The Lake of the Woods region is somewhat off the beaten track, and the Commission had in many respects to blaze a new trail.

The results of many of these surveys and observations have been previously published in numerous articles in *The Canadian Engineer*.

The International Joint Commission consists of six members. The three appointed by the United States are: Hon. Obadiah Gardner, of Rockland, Maine; Hon. James A. Tawney, of Winona, Minnesota; and Hon. Robert B. Glenn, of Winston-Salem, North Carolina. The three appointed by the Canadian Government are: Charles A. Magrath, of Ottawa; Henry A. Powell, K.C., of St. John, N.B.; and Paul B. Migault, K.C., of Montreal. Senator Gardner and Mr. Magrath are the joint chairmen of the Commission.

It has been calculated that the rivers of European Russia alone, excluding the Caucasus, are capable of producing 1,000,000 horse-power. Together with Siberia and the Caucasus, Russia possesses reserves of this energy which exceed 10 million horse-power.

NEW DESIGN OF SCREEN CHAMBER.*

By John H. Lance,
Consulting Engineer, Wilkes-Barre, Pa.

IN the use of water for supply purposes its freedom from foreign bodies is of prime importance. While ordinarily, the water of driven or dug wells or infiltration galleries is free from detritus, all stream, reservoir and lake supplies require careful screening before the water may be admitted to the distribution system. Among the bodies to be removed from the water are grass, leaves, sticks, bits of bark, and fish; and by far the most troublesome of these are leaves in all stream and

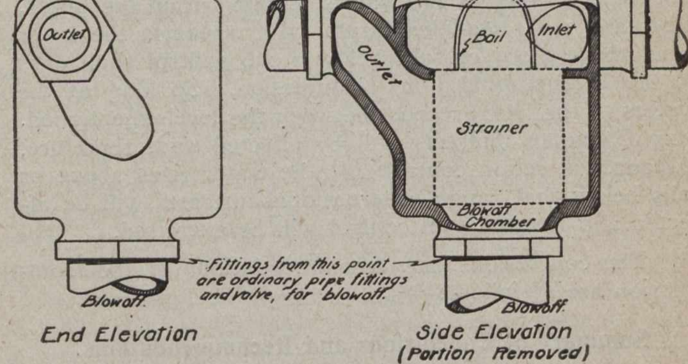


Fig. 1.

small reservoir supplies. Masses of water grass only occasionally move to the point of intake; sticks, etc., usually only by reason of a high stage of water in the source of supply. Unlike these substances—which do not often of themselves form, by lodging against the screen, a tight barrier to the passage of water—leaves may practically seal the screen and effectually shut off the supply. This result may be caused also, but rarely, by small fish, of such a size as to be unable to resist being carried by the current at the intake. When they have been held against a screen for 24 hours these fish make a tight seal and a very difficult coating to remove, one that does not readily release when the pressure is removed, as do leaves. Only the rarity of conditions favoring such occurrences spares the waterworks operatives a vast amount of trouble. On the other hand, the leaf nuisance, especially in supplies from small reservoirs and streams, makes constant demands upon the attention of the operatives for a considerable part of the year.

The customary method of removing these substances is to install at the intake of the supply main a screen affixed to the pipe, or two sets of screens in series, which may be drawn up out of the water for cleaning and replaced again for service. The former arrangement, which is applicable only to very small depths of water on the screen, is economy itself in first cost, but its use has not always proved so economical, as, owing to any one of many causes, the screen might not receive the necessary attention at the very time when it was most needed. The latter necessitates a considerable structure to hold the screens in place and house them while being cleaned. If the reservoir is of great depth the process of cleaning is tedious and expensive, involving, as it does, the hauling up of all the screens in one set and their replacement for each cleaning. During the time of cleaning the upstream

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*Paper read before the American Waterworks Association, May 9th, 1917.

set the downstream set is receiving leaves and trash. While the cleaning of this set takes place much of the debris lying against the screen and any fish between the two sets go down into the supply main to appear at the various fixtures of consumers or block the operation of meters.

To obviate these difficulties the pressure screen-chamber here described was designed. It consists essentially, as shown in Fig. 3, of a vertical cylinder divided by a horizontal diaphragm into two compartments. The upper, or inlet compartment, has communication with the lower, or outlet, through a circular opening in the diaphragm, and thence through the meshes of an open-ended cylindrical screen resting in the lower compartment of a diameter nearly that of the opening. The lower end of the screen is concentric, with the end of a blow-off pipe with a gate valve on it, normally closed. The inlet pipe enters the inlet compartment tangentially, while the outlet may leave in any direction relative to that of the inlet, preferably in a radial position. Any flow from the inlet pipe sets up a whirling motion in the water in the upper compartment. In passing through the screen cylinder it has a circumferential as well as a downward motion, which, owing to the passage of water through the meshes of the screen, diminishes as the bottom of the screen is approached. The result of this is to confine, largely, the foreign matter carried by the water to a central cone, the base and height of which are approximately those of the screen. The upturned end of the blow-off pipe being made of nearly as great a diameter as the screen, this results in an accumulation of debris directly in the pipe. When blocking of the screen has progressed to a point at which there is a noticeable loss of head at the screen, as measured—preferably by a mercury U-tube or a differential gauge—the blow-off gate is opened. The head in the blow-off pipe is then reduced to zero, or nearly so, the hydraulic gradient from reservoir to screen-chamber is increased, and the high velocity established is transmitted directly to the water passing diagonally downward over the face of the screen and out the blow-off pipe. Ordinarily, the cleaning of the screen is accomplished in about the time that it takes to open and close the

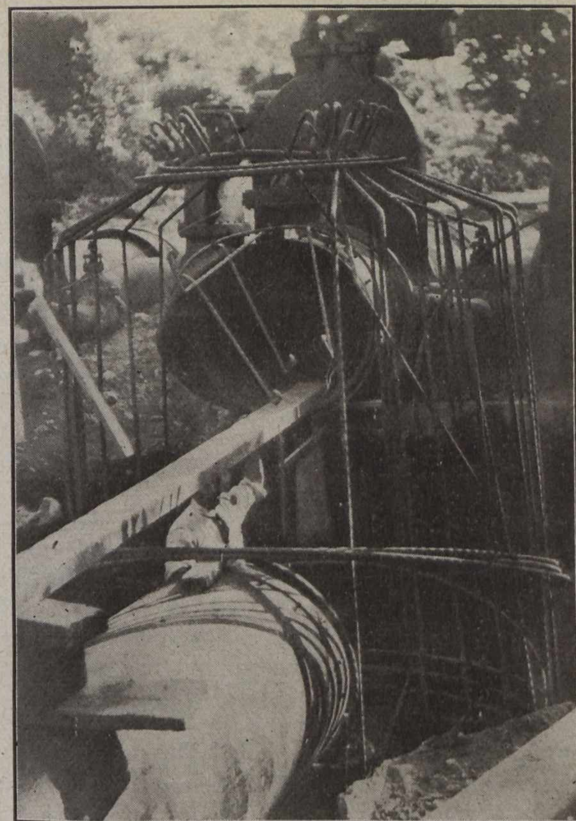
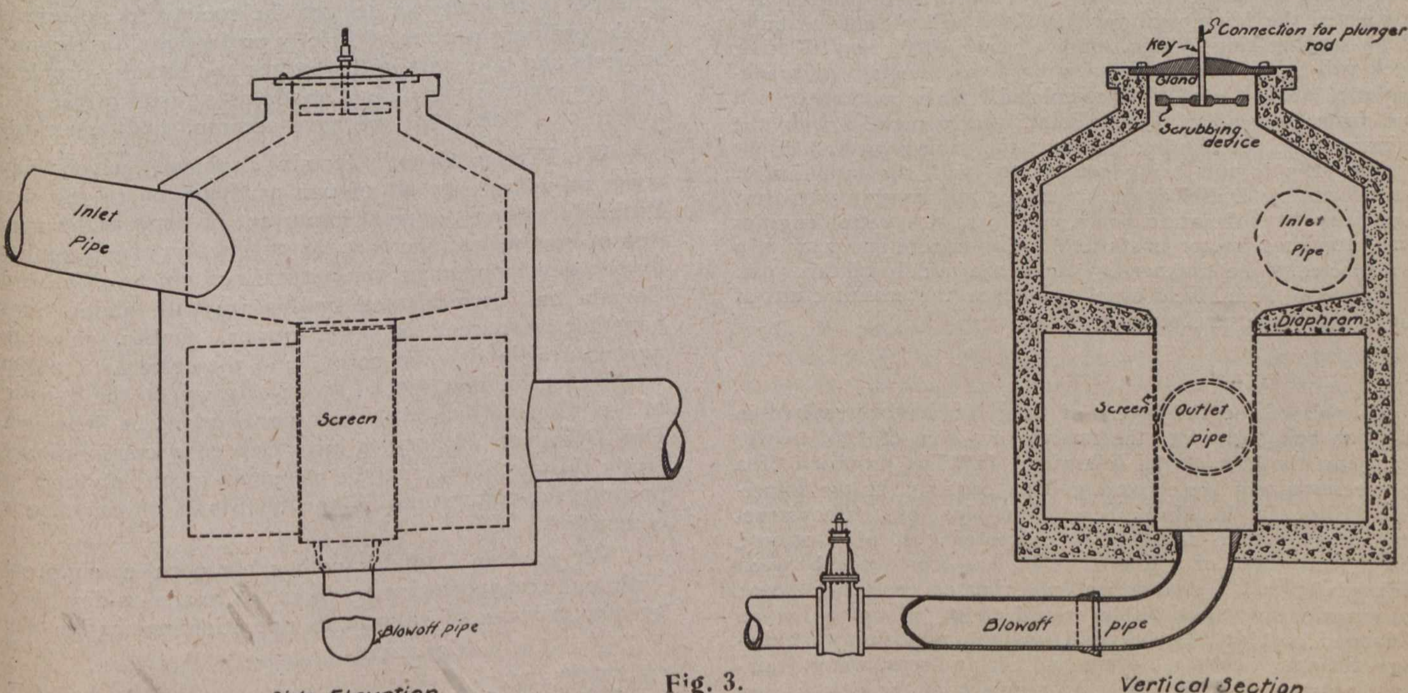


Fig. 2.

blow-off gate. If it is desired to maintain a considerable continuous flow through the outlet pipe the blow-off gate need not be opened wide, in which case the operation will require a longer time. Under no conditions is an appreciable amount of water wasted.

Also incorporated in the design is a hollow segmental brush for use in cases when the screen does not get attention for such long periods that a deposit of small fish is not readily removed by the flowing water. For the intake pipes of pumping stations the devices are best set in batteries of two, so arranged that one can be put



Typical Cross-section of Trench.

Fig. 3.

in service while the other is being cleaned. In this case the cleaning is preferably done by jets of high-pressure water directed downward from the edge of the diaphragm across the screen. Where electric power is available the use of proper contact devices at the point of measurement of the loss of head at the screen will make the entire screening operation automatic, both for gravity and pumping supplies.

For use with a gravity water supply, the devices have been found to operate most successfully between the heads of 40 and 60 feet, though there is no valid objection to their use at other heads under certain conditions. They are made entirely of reinforced concrete, with the exception of the manhole cover, which is of cast-iron. Fig. 2 shows one of two screen-chambers under construction on two 36-in. mains under a head of 60 ft.

The principle of pressure screening, from which the design was developed, was first suggested by Mr. O. M. Lance, general manager of the Spring Brook Water Supply Company. The operation of the screen-chambers has been found to be so economical and efficient that they have been adopted as a standard by the above-named company as convenient. Its supply lines, twenty in all, will be equipped with the new device and the old sliding screens removed, only bar screens being left in place.

The application of this development is quite wide and covers a variety of uses, such as meter fish-traps, sewage sludge screens, etc. It is covered by letters patent. Fig. 1 shows a small cast metal screen chamber for use with a meter.

SHIPBUILDING IN JAPAN.

Large extension of equipment is projected by the Mitsubishi Dockyard and Engine Works at Kobé. This company is to build four steamers this year, ranging from 2,000 tons to 6,000 tons, while the construction of other vessels is also contemplated. To meet the increased demand for building capacity, the management has undertaken the construction of two new docks, and a new floating dock of 20,000 tons lifting capacity. It is said that when these projects are completed the Mitsubishi yard in Kobé will be able to build ships aggregating 60,000 tons a year. The new floating dock will be moored in the new basin as soon as the breakwater of about 1,000 ft. is completed. This breakwater will run from the end of Wada Point, nearly parallel with the existing inner breakwater of about the same length. A new engine shop is now being constructed with the intention of manufacturing Diesel engines for land and marine purposes, especially for submarine boats, together with petrol engines for aeroplanes, motor boats and motor cars. The new shop is expected to be finished by about the middle of this year. It has also been decided to commence the manufacture of the "Stal" type of steam turbine.

A poll of the ratepayers of Cape Town has resulted in sanction being given to the raising of a sum of £268,000 for defraying the cost of the following: (a) The provision of a new reservoir of 200,000,000 gallons capacity in the Silvermyn Valley, in the Muizenberg Mountains, by the construction of a concrete dam, at an estimated cost of £205,000; (b) the provision of a line of 12 in. cast-iron pipes between Muizenberg and Newlands, at an estimated cost of £35,000; (c) certain investigations in regard to water supply, at an estimated cost of £15,000; and (d) the provision of buildings, fittings, cleaning, drying and curing areas, water drainage, sanitary conveniences, etc., required at the new fishing harbor, at an estimated cost of £13,000.

OUR WAR PROBLEMS.*

By J. S. Dennis,
President, Canadian Society of Civil Engineers.

I UNDERSTAND the main object of your gathering here is to consider the question of a possible federation of the engineering associations or societies in the United States so as to bring about better results. It occurs to me that federation has never been accomplished in an entirely peaceful manner, which leads me to the thought that perhaps that is the reason why your chairman has included me on the program to speak on the subject of war problems.

Your own federation in the United States, when it saw fit to cut loose from the British Empire, was not accomplished in a peaceful manner. The subsequent effort to maintain your federation through the Civil War was not peaceful. The federation of our British colonies also led to bloodshed, and therefore it is natural for us to expect that largely scattered and diversified interests like those of the multitudinous engineering organizations on your side of the line or ours, cannot be federated or consolidated without trouble, but there is no doubt whatever in my mind that if, as a result of your conferences here, anything in the way of federation of the different societies can be accomplished, you will have made a great step forward.

We in Canada have the same problem confronting us. We have all the branches of the engineering profession represented there in different societies or clubs, and our desire is to try and federate and consolidate them into one central organization, at least, in so far as a central board is concerned.

Our main object in the Canadian Society of Civil Engineers is to encourage, as far as Canada is concerned, exactly what I understand you are aiming at,—that is, a federalization of all of the engineering societies in Canada, and we have under consideration the change of our name so as to extend an invitation for all to come in and create a big federal organization. My particular object this year, as president of the Canadian Society of Civil Engineers, is to endeavor to get the society to go outside of the ordinary routine of strictly professional or technical subjects and take part in the bigger and broader problems that are confronting us in Canada as a result of the war, and in this I may say we have accomplished something.

We have in Canada certain problems which have come to us as a result of our participation in the war. Probably among the most important of these is the question of how we can increase the production of our country by the development of our natural resources. We think Canada has been blessed by Nature with almost inexhaustible resources of water-power, timber, minerals, agricultural lands, and so on, and therefore as a society we are urging that special study be given to the question of how Canada's natural resources can best be developed. Our Dominion authorities have created a commission to study this problem, and the chairman of one of their important sub-committees is the chairman of our finance committee.

We have in Canada another big problem connected with out transportation systems. Canada to-day has a greater mileage of railway in operation per capita than

(Concluded on page 527.)

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*Abstract of address before the Third Conference, Committee on Engineering Co-operation, Chicago, March 29, 1917.

CANADA'S RAILROAD PROBLEM

The Objections to Government Ownership—Party System Militates Against It—State Ownership and Inefficiency.

By W. T. JACKMAN, M.A.,
Dept. Political Science, University of Toronto.

NOTE.—The following article is the second of a series of three. The objections to Government ownership of Canadian railroads are discussed. In his first article, published in our May 3rd, 1917, issue, Mr. Jackman considered the advantages of Government ownership. In the third article, he will propose remedies for our existing difficulties. Mr. Jackman is not an engineer, and his opinions are expressed from the economic viewpoint only, but they will no doubt interest readers who have followed the papers by Messrs. Tye and Tait and the report of the Railway Inquiry Commission.—Editor.

HAVING looked at the advantages of government ownership, it will be well to consider, in the next place, the objections to or disadvantages of government ownership. In the administration of a railway system or any other large enterprise, prompt action is an imperative necessity in order to be able to meet the emergencies that are constantly arising. There is need for instant action in the despatch of business and in order to secure judicious outlay in the interest of economy. The many changes in commercial conditions, of which business men endeavor to take advantage, should be met by the agents of the railway companies armed with authority to grant traffic arrangements to meet the necessities of their patrons. A delay of even a few days may be fatal. So, too, in regard to line expenses; the replacing of a bridge in time, the ballasting of the road-bed when required, the changing of gradients and curves, and many similar items, when effected at the proper time will save large amounts in the expenses of operation and in many instances will provide the public with greater facilities and greater security. When private control is exercised the management is left in the hands of a capable executive, from whom immediate action may be obtained under all circumstances. In this way, not only the welfare of the company may be secured but also the interests of the public may be advanced. But Parliament is too unwieldy a body through which to secure immediate action. Any measure which is brought before the legislature becomes at once the subject of discursiveness in debate. It is referred to a committee for recommendation and the minute regulations under which Parliament proceeds, being determined by law, leave no power of initiative to the railway executive. Since the master has no power of initiative it cannot delegate any to the servant.

Parliament is Too Slow.

Parliament is altogether too slow in its deliberations to be the directorate of a great railway system. Its members, representing widely separated localities with much diversity of interests, are sent to Parliament to act for the well-being of their own sectional or partisan interests and are in nowise able to see things from the larger point of view when it comes to the time for casting the vote. Out of this confusion of interests we cannot expect and do not find decisive action for the public welfare. Decisions which are finally reached are mostly compromises in order to adjust most amicably the vast variety of interests; and such indecision and compromise are fatal to the success of any large business of an economic character.

No official can administer the affairs of such a complex and changing mechanism as a railway system with even reasonable efficiency unless funds are at his disposal when they are needed. If otherwise, waste goes on, with misfortune to the property, to the owners, to the bondholders and to the public. When authorizations of funds are delayed for months, and sometimes for years, the effect is invariably and unavoidably increased cost of construction, maintenance and repair work, together with increased interest charges the longer the appropriation is delayed, and greater loss through the deterioration of the plant. It cannot be otherwise. Taking this in connection with the administrative expenses, which go on whether the property can be operated efficiently or not, we have a clear view of one great reason why governmental activity should not be exercised in regard to the administration of railways.

Party System and Railroads.

Another factor which militates against government ownership of the Canadian railways is our party system of government, with all that this includes. At a change of the party in power there is always so much undoing of work that had been done by the previous party in control. An uncertain, unstable policy of government is not conducive to the building up, upon a permanent basis, of a railway system that will be of national importance. In building for the future those who are entrusted with these responsibilities need to be assured that a continuously consistent policy will be shown, so that enterprises which have been initiated may be assured of completion. But this is impossible under our government with its vacillating policy, for public works which have been supported by one party when in power will be relegated to obscurity by the other party when it secures control. The result is that such works lack adequate continuous financial support until their completion, and so we have piecemeal construction, patchwork planning and temporizing operation. Public enterprises, like those of a private nature, must have the continuance of conditions upon which they can depend in order to build for the future; the lack of this essential would surely prove detrimental in devising the means for meeting future needs and emergencies. The influences of party and sectional demands have been all too apparent in recent years since the rise of the great agricultural western provinces, and while we do not, in the least degree, condemn those who have such influence for exercising it for the improvement of their economic condition, it furnishes us a striking example of the way in which partisan claims secure recognition at Ottawa.

Works for Inefficiency.

In a democratic state, not only has the direction of state-owned railways an overwhelming tendency toward inefficiency, but even the management partakes of the same character. We will recognize, however, that there are exceptions to this rule. Managers are not chosen because by training and experience they have fitted themselves to direct the affairs of a great enterprise, for government officials are usually selected on another basis than ability and aptitude in the special line of duty to which they are assigned. It does not follow that, because a man has ability in business life or skill as a physician or lawyer, he can be placed at the head of large railway interests after he has had experience in Parliament.

The work of a capable railway executive is as much a specialized calling as is that of a doctor or lawyer, and for its successful accomplishment requires training and intellectual ability of a high order combined with broad practical experience in the important grades of the service. To place any other kind of man at the head of a great railway would be to place a premium on incompetency, to create a misfit in one of the most important offices of the public service and to give rise to demoralization of the entire body of servants in the integration of their activities. In order to acquire a knowledge of any of the higher positions in the railway service a long period of educative and disciplinary experience is required; and in the case of the highest official, upon whom devolves the responsibility and control of the entire system, it would be a gross delusion to think that one without any railway experience, or even one with experience in only one aspect of the service, no matter how great might be his ability along other lines, could adequately measure up to the demands attendant upon this office. Moreover, under our form of popular government administrative officers are frequently changed and with changes in the heads of departments there are many changes also in the important clerkships under them; and until these new men learn the details of their business their work bears the impress, to say the least, of immaturity and incompetence. Such conduct in connection with the railways of the country would be disastrous from every point of view. Expediency, under these circumstances of political change, would lead the officials of a railway to make a good showing in connection with the business over which they were given the temporary control; but in order to make a good showing in governmental enterprises we have seen the permanent upkeep and expansion curtailed in order that the affairs might show a favorable balance of profit. This tendency of managements, whether municipal, provincial or national, leads to a continuously short-sighted policy of retrenchment in necessary expenditures; and when due correction is made of the "favorable balance," upon grounds of prudential disbursement, the result would, in many instances, be a deficit.

Initiative is Checked.

Again, the relation of the executive to the directorate in governmental enterprise is not such as to lead to efficiency. The constant ebb and flow in industry and commence which are so marked a feature of all our economic life necessitate frequently immediate action on the part of railway officials. We have seen this exemplified in many ways in the past few months, by the exigencies attending the moving of the crops last autumn and the provision of a supply of coal and agricultural necessities during the present winter. Under these conditions, the railway manager requires to have large authority and discretion vested in him, so that he can meet the unforeseen situations most effectively. But, were he the servant of government, he would not be allowed to act upon his own initiative, for under our government executives are restricted in their power so that the rights and liberties of the people may not be abused but fully conserved. To circumscribe an executive in this way, and cause him to act under a diffused authority which is so remote from him that he cannot secure immediate consultation, is to paralyze all his efforts, be they never so wisely conceived, and to induce indifference and inertia. Of course, the same characteristics tend to be produced in the men who are working under such an executive. This is one of the most incisive arguments against government ownership. How can a railway manager secure results unless he has full discretion as to methods to be pursued and the personnel and promotions of the men who are to be his most intimate and trusted associates?

Finally, the management, under government ownership, has lost all the incentive of self-interest, which is such a potent factor in securing the great results that have flowed from private ownership. Giving due consideration to the evils which have followed private ownership, will anyone say that the unprogressiveness and lack of interest of government employees, the great army of whom know that promotion is for them a question of remote possibility, does not bring as great, if not greater, evils for the community? In the case of a great corporation, each employee wants to do his best in order to secure the promotion and other recognition that he desires. Only in this way can he secure this result, for it is very rare that, in a private concern, an incompetent will be advanced over the head of a competent individual. But promotion is not obtained in this way in government service, for here all the elements of personal influence and political favoritism which are commonly included under the term "pull" are invoked in order to bring preferment to a particular candidate.

To be sure, where civil service rules are applied the above methods are modified in a degree. But lack of immediate and personal self-interest on the part of government employees tends to retard or prevent the latter from displaying the inventiveness and resourcefulness which characterize the servants of a private corporation and which are such an important feature in the development of industry and enterprise. The inability of the individual to secure recognition tends to degrade the standards of personal efficiency in government service; and this would have very unfortunate ulterior results were the railways to be taken over by the government.

Financial and Political Objections.

In addition to the foregoing objections from the standpoints of control and active management, there are also financial and political reasons why government ownership is undesirable. Granting that the government could borrow, at the rate of, say, 3½ per cent., all the money required to refund the outstanding bonds of the companies, those persons and institutions which now hold these bonds would have to accept in lieu of them the government bonds bearing the lower rate of interest. This reduction in the earnings of the securities would bring financial difficulties to banks, insurance companies and private individuals as owners of these securities. But it is greatly to be doubted if the government could borrow all the money it required for such a large financial venture as the purchase of the country's railways and of adequate facilities in the way of rolling stock and terminals to handle the increasing volume of traffic.

It is able, under ordinary times, to borrow at such low rates simply because it has not abused its credit. But the facts which have been brought before us on account of the war have put an altogether new look upon the problem of finance. Even those great countries like England and France with almost unlimited credit have had to pay much higher interest rates for their increasing necessities; and Canada, in order to secure her latest borrowings, has had to offer a rate of interest enormously greater than we have assumed above for purposes of argument. If these high rates had to be paid by the Dominion for the capital required to finance the purchase and equipment of her railways, the financial argument for government ownership would be utterly ludicrous. As an addendum to this, we must note that if the Dominion government took over the railways, the provinces would lose in taxation a considerable amount of money—in 1915 the tax bill was $3,049,727.62.

The political argument against government ownership of the means of transportation is also strong. In

Parliament, representatives from the various and widely scattered sections of the Dominion meet to consider measures for the country's welfare; but each of these men, by the mere fact that he is the representative of his own community or class, is, by implication, bound to do all he can for his own constituency. Now, the government acts according to the amount of pressure that can be brought to bear in connection with a particular issue; that is, according to the number of votes which that issue can command. Hence, the greater the number of votes which can be secured in favor of a bill the greater is the probability that such a measure will be enacted into law. It is evident, therefore, that one of the advantages of government ownership which we have explained rests upon a very slippery foundation; it is not by any means the needs of the various sections of the country that is the basis for their consideration by Parliament, but rather the influence that can be exerted by all the forces to which the legislature has to listen.

Let not the advocates of government ownership think that with all these transportation facilities in the hands of the government a "square deal" will be received by every locality; for he who realizes how the government does its business will be fully conversant that this much-desired equity would not be initiated or applied under the proposed control. Those sections which can bring forward the greatest pressure will get the "plums"; and other sections will be left without the means of conveyance and communication until they can exercise sufficient influence politically to compel recognition of their needs.

Increase in Employees.

Another phase of this political argument is that whenever governments have taken over railways from private control there has invariably been an increase in the number of employees who are given positions in the service. The necessity of giving these appointments so as to secure the largest number of votes is recognized by all parties. This would have a two-fold influence: in the first place, the large increase in the number of employees would soon be in a position to cause even their superiors to tremble before them; and in the second place, the large increase of expenditures in salaries and wages would soon be followed by the necessity of higher rates out of the proceeds of which to pay the larger pay-roll. In the event of failure to provide the higher rates, the management would have to call upon the government for greater appropriations of public funds to make up the deficits from revenue. But the political side of this issue can be easily seen when we note that with a greatly augmented force of government officials and employees the latter might be able to hold the balance of power between two parties and thus compel the payment of higher wages or the grant of shorter hours or other privileges.

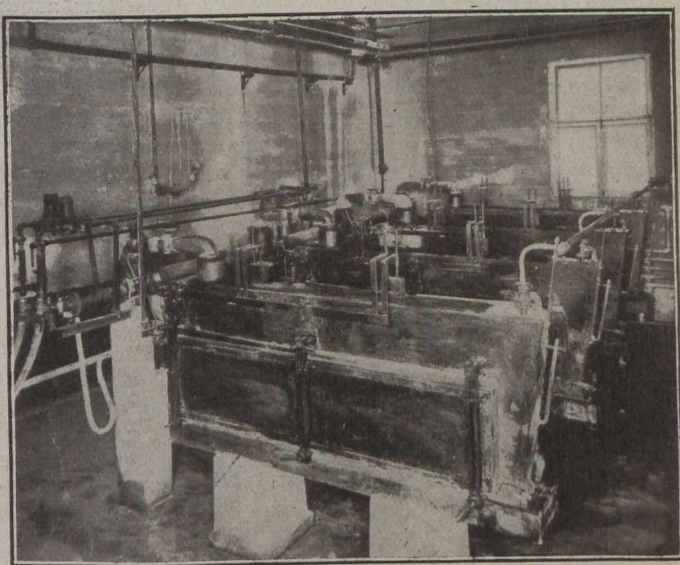
ELECTRICAL BOARD NAMED.

George L. Guy, electrical engineer for the Manitoba public utilities commission, J. M. Leamy, provincial electrical engineer of Manitoba, and G. J. Brown, assistant to Mr. Leamy, have been appointed a board of examiners under the act for the licensing of electricians. The board will have to arrange for an examination of candidates before the end of the year, as after January 1, 1918, penalties will be imposed on all electricians working without a license.

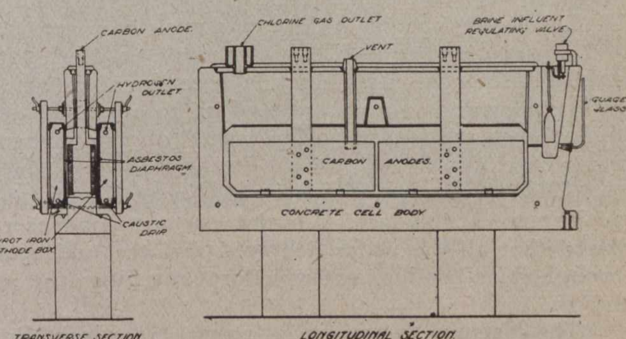
The electric furnaces of Sheffield, England, can now produce 90,000 tons of steel per year, and in 1918 it is anticipated that the output from these furnaces will be 150,000 tons.

MONTREAL WATER AND POWER COMPANY'S CHLORINE CELL INSTALLATION.

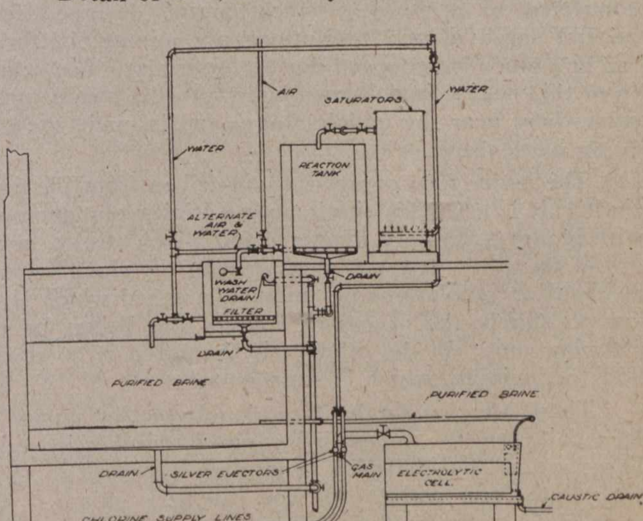
Under the above heading an article appeared in the May 31st issue of *The Canadian Engineer*, by F. H. Pitcher and J. O. Meadows. Through the courtesy of Mr. Sutherland, assistant chief engineer of the company, we have since been placed in possession of the following two drawings and one photograph, which will be of interest to engineers who have read the aforementioned article.



View Showing the Four Electrolytic Cells in Use.



Detail of Cell, Electrolytic Chlorine Plant.



Sectional Elevation Showing Brine Purifying Apparatus and Electrolytic Cell.

DUTY TRIALS ON PUMPING ENGINES AT JOHN STREET STATION, TORONTO.*

By Robert W. Angus, B.A.Sc.,
Prof. of Mechanical Engineering, University of Toronto.

ALL of the water used by the city of Toronto is pumped through the main pumping station at the foot of John Street. This station is equipped with a number of steam-driven pumps and also a number of electrically driven units, the latter receiving electric current from the general city supply. In so far as the electrically driven units can be operated without raising the city's power peak, they are kept in service, but whenever the electrical operator finds that the peak is being approached, he has one or more electrical pumps stopped and then the delivery pressure of the station may slightly decrease while a steam pump is being brought into service, but, on the whole, these variations in pressure and in supply are not noticeable in the city.

Description of the Units.

Some few years ago it was decided to increase the pumping capacity of the main station, and, with this in view, a new pump room with adjacent boiler room was built. The pump room now contains five pumping units, two of which are driven by induction motors, and three of which have been built by the De Laval Company, and are driven by steam turbines. It is with two of the latter pumps that this report deals.

Each unit consists of a De Laval steam turbine connected through a reduction gear to a pair of centrifugal pumps, which are connected so as to work in series. The units are exact duplicates. The turbines are of standard De Laval construction for steam pressure of 150 pounds and a vacuum of 29 inches, the normal speed being 3,430 revolutions per minute. Each is direct-coupled to a speed reduction gear having a ratio of 33 to 197, so that the pump shaft rotates at normal speed of 575 revolutions per minute.

The steam supply pipe is 4½ inches, with 36-inch exhaust to a standard Wheeler surface condenser, so placed that all the water delivered by the unit passes through it as cooling water before reaching the main pumps.

The vacuum pump is a 20-inch x 40-inch Rotrex pump built by the C. H. Wheeler Company, and is direct connected to a 7-inch x 7-inch engine designed for a normal speed of 200 revolutions per minute, but which ran at a much lower speed during the trials. The exhaust from this engine is delivered back into the steam turbine somewhere near the middle stage, and is made use of in doing work there.

The boiler feed pump is chain-driven from the pump shaft. It is a Goulds single acting triplex plunger pump with plungers 3½-inch diameter and 6-inch stroke, and in one of the units the crank shaft driving the plungers turns at about 47 revolutions per minute, a speed which is too low to supply the necessary feed to the boiler for this pumping unit; in the other unit the speed is 66 revolutions per minute, which is satisfactory.

There are two single-stage double-suction pumps on each unit, the two pumps being piped together in series. There are no outside guide vanes, but the castings are of the volute form and the pumps run very quietly. The name-plate states that the pump is designed for a total head of 250 feet, and a discharge of 20,000 U.S. gallons per minute (which is equivalent to 24,000,000 Imp. gallons per 24 hours) at a speed of 575 revolutions per minute.

The water piping begins with a 42-inch suction, which is the size of the inlet to the condenser. At the condenser outlet the diameter is reduced to 36 inches and this is again reduced to 24 inches where it enters the pump. The series piping between the pumps is 30 inches, being reduced to 24 inches at the point of connection with each pump. To the discharge end of the pump a 24-inch x 36-inch tapering enlarger has been attached to connect with the 36-inch discharge main. The inlet and outlet openings on all the pumps are 24-inch diameter. The pump impellers are of bronze.

The Duty Trials.

The duty trials on the machines were run on March 6th and 8th, 1917, respectively, and in order to see that the conditions were uniform before the tests began, the machines were run for at least an hour under full load immediately preceding the duty trial.

The boiler fires were properly cleaned, and everything put in as good condition as possible to insure uniformity, but some slight variations naturally occurred. It was necessary to run the trials during the daytime, owing to the demand for water in the city, and therefore an effort was made to start as near seven o'clock in the morning as possible, although in both cases the trials did not begin till nearly an hour later.

The city's electrical power peak occurred shortly after the trial began in each case, and the electrical pumps were therefore shut down, causing a heavy draught on the pump under test. There was a consequent decrease in pressure, but as the discharge increased at the same time, the load on the steam turbine driving the pump did not vary greatly. Throttling of the pump discharge was temporarily resorted to, in order to prevent undue fluctuations, and another steam pumping unit elsewhere in the station was put into service as quickly as possible, but the extra draught of steam from the boilers caused some slight variations in steam pressure. All of these variations, however, were of short duration and were productive of but slight inconstancy in the general conditions, and the machines were given exceptionally steady loads during their entire trials.

Conditions Governing the Trials.

In the contract dated August 14th, 1914, the conditions governing the conduct of the duty trials are given, and the following clause referring thereto is copied here for reference:—

"59. While the duty specified for the steam turbine driven unit is 120 million foot-pounds, tenders are requested to state any higher duty they are prepared to guarantee, and any higher duty guaranteed, together with the contractor's ability to fulfil same, in the opinion of the commissioner, will form a factor in the awarding of the contract. Should the contractors guarantee a duty in excess of that specified, when using saturated steam containing not more than 1½ per cent. of entrained moisture, the duty guaranteed will be substituted for this amount, and for each one million (1,000,000) foot-pounds in excess of the guarantee the corporation shall pay to the contractor the sum of fifteen hundred dollars ($1,500), and pro rata for fractional parts, but the total bonus shall not exceed seven thousand five hundred dollars ($7,500). Should the duty as shown by the official trials be less than the guarantee the commissioner shall deduct from the

*From report made to R. C. Harris, Commissioner of Works, Toronto.

amount paid to the contractor the sum of two thousand five hundred dollars ($2,500) for each one million (1,000,000) foot-pounds unperformed, and pro rata for fractional parts down to five million foot-pounds less than the guaranteed duty.

"If the duty as shown by the official test be more than five million foot-pounds below the guaranteed duty, the commissioner may, at his option, reject the unit, and in case of such rejection, the contractor shall return all moneys paid to him on account and shall, without compensation, allow the unit to remain in the service and under control of the commissioner for such a time as may be required to install a new unit, and shall fully reimburse the city for any loss or damage suffered by reason of the contractor having failed to fulfil his guarantee."

In accordance with clause 59, the contractors guaranteed a duty of 141.5 million foot-pounds of work per 1,000 pounds of steam used, and this duty was therefore inserted in the contract.

Details of the Trials.

The duty trials were run in exact conformity with the specifications, with the single exception of the duration of each, which is specified as twenty-four hours. On discussing the matter with the city's engineers, it was found that the conditions in the station made such a long run very undesirable, and it was agreed that the run should be shortened to ten hours. The contractor agreed to this. There is no doubt that the results for the ten-hour period would be practically identical with those for twenty-four hours.

The specifications require that the gauge pressure on the boilers supplying the turbines shall be 150 pounds per square inch. A battery of four boilers was used in each case, and on top of each boiler there is a stop valve bolted to the steam drum, and from the top of this stop valve the steam pipe from the boiler leads to a header which is common to all boilers. To this header the supply pipe for each pumping engine is connected by a fairly long, well-lagged pipe.

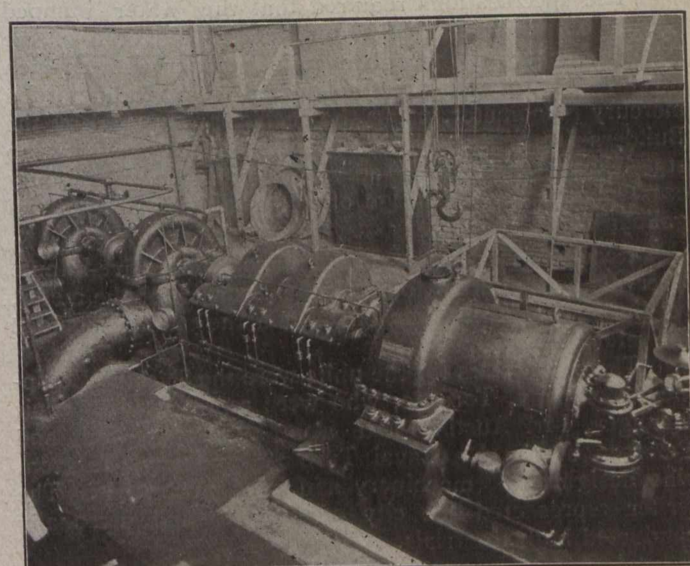
To avoid any possible sources of loss in the boiler stop valve, the gauge used on the trial was connected to the steam pipe within six inches of the stop valve. The gauge pipe was so arranged that the gauge was brought down to the level of the fireman's eye, and correction was made for water column. An observer remained constantly in the boiler room so as to keep this pressure uniform, and readings were noted every 15 minutes.

The quality of the steam was taken by throttling calorimeter attached to the steam pipe about six inches from where it entered the turbine stop valve. For the purpose of determining the quality, the engine pressure was taken and is also recorded; it was taken at the point where the calorimeter was attached. These readings were at 15-minute intervals.

To determine the exhaust steam condition, both a mercury column and a thermometer were used, the mercury column being attached to the turbine casing slightly below the level of the main shaft, while the thermometer was inserted in a cup in the exhaust pipe about half-way between the turbine casing and condenser. Much care was taken to push the thermometer well into the cup, so that the bulb was at least 9 inches in from the pipe wall, and the mercury column connections were also carefully tested for leakage. A comparison of the two readings shows that the temperature is lower than that corresponding to the mercury column, possibly due to the difference in location, and partly to the presence of air in the exhaust. Both results are quite accurate and equally reliable.

The speeds were taken with an ordinary revolution counter, or else were actually counted, those on the main pump being at 15-minute intervals; the others were not so frequent. It was not possible to get the speed of the steam turbine directly, and hence it had to be calculated from the pump speed, using the gear ratio given by the contractor of 197 teeth in the gear to 33 teeth in the pinion. The pump and turbine speeds were well below the maximum specified.

To get the steam used during the trial, the ordinary pipe for delivering the condensate into the feed tank was broken and a connection put in so that the water was delivered into a storage tank, from which it was run into a tank on scales as desired. The leakage from the air pump glands was caught and has been added to that coming directly from the air pump discharge. There was only one trap on the turbine plant, and as it was plugged no leakage occurred there.



Steam Turbine Driven Pumping Engine at John Street Pumping Station, Toronto.

On the first unit tested the gland leakage was not great, but as it was in the form of steam it could not be measured. In the second unit the leakage was much more marked, due to defective carbon rings, but the steam thus escaping would not have formed any appreciable proportion of the total, and its effect on the duty would be very slight.

The weighing tank was capable of holding a net weight of only about 1,000 pounds, and, in order to keep well within the limits, the weight of steam condensed every three minutes was taken. In order to have no error due to the storage tank, the water in it was brought to the same level at the end of the test as at the beginning. All weights were taken to half pounds. The steam used by the air pump is automatically included with that from the turbine, and the feed pump was chain-driven from the pump shaft.

For convenience and greater accuracy the pressure and suction gauges were both piped to the same point, close to the suction inlet pipe, and in the results allowance was made for the difference in levels between them.

Before the test began, considerable discussion took place between the contractors and myself regarding the position of the discharge gauge connection, and also as to whether velocity head was to be allowed for. In this connection it is pointed out that the suction pipe up to the condenser is 42-inch, and the discharge outlet from the pump 24-inch, and a tapering enlarger and valves are used to connect the 24-inch pump outlet to the 36-inch delivery pipe provided by the city. The difference in pressure between the two ends of this enlarger was slightly over 7/10 pound per square inch, being greater at the 36-inch end, and amounted to about 7/10 of one per cent. of the total head. The nature of the specifications prevented allowance being made for difference in velocity head between suction and discharge pipes, and it was also agreed that the discharge connection should be placed on the outlet from the pump where its diameter was 24-inch, and the results are reported on this basis.

The discharge pressures were taken with a sensitive Bourdon gauge, and the suction pressures by mercury manometer; there was always a slight pressure in the suction pipe at its centre line. Both readings were taken every five minutes, the discharge gauge being carefully calibrated.

The specifications required that the water pumped should be measured by Venturi meter, and both of the pumps discharged through a 36-inch meter with 21-inch throat. The quantity was calculated from readings of a mercury manometer, using the coefficient supplied by the Builders Iron Foundry, the makers of the meter, who state that a manometer reading of 5.07 inches of mercury corresponds to a discharge of 25.30 millions of Imperial gallons daily.

Readings were taken on the manometer at five-minute intervals, and in order to check the recorder for the meter, readings were also taken on it, and the results included for reference.

The contractors for the units were the Turbine Equipment Company, Toronto, who were represented by their manager, Mr. Austin, and also by Messrs. Salt and Petersen of the De Laval Turbine Company, Trenton, who designed the machinery and built much of it. The writer represented the city of Toronto and personally conducted both the trials.

Remarks on the Trials.

The results obtained on the units are a matter of great satisfaction, partly because they have so far exceeded the guarantees of duty, and partly because the results are exceptionally high for this class of pumping unit, and have probably not ever been exceeded by any similar unit running under similar conditions of steam and of equal water pressures.

General Dimensions of the Units.

(Both are exactly alike.)

Turbine.	
Normal speed ....revs. per min.	3,430
Diameter of steam pipe ....in.	4.5
Diameter of exhaust pipe ....in.	36
Double Helical Reduction Gear.	
Number of teeth in pinion	33
Number of teeth in gear	197
Ratio of teeth	5.97
Pump speed corresp'd'g to turbine speed above	575
Pump.	
Number of stages	2
Suction and discharge openings ....in.	24
Suction inlet to condenser ....in.	42
Size of city's discharge main ....in.	36
Enlarger from pump discharge to main ....in.	24 x 36
Rated speed ....revs. per min.	575
Air Pump—Wheeler Rotrex.	
Size ....in.	20 x 40
Size of direct coupled driving engine ......in.	7 x 7
Rated speed ....revs. per min.	200
Feed Pump—Goulds Triplex Single Acting.	
Size of plungers ....in.	3½ x 6
Speeds in the two units ....revs. per min.	47 & 66

Results of Duty Trials.

	Westerly unit.	Easterly unit.
Average barometer reading ....in.	30.06	29.43
pounds per sq. in.	14.77	14.45
Pressures and Temperatures.		
Average boiler pressure—pounds per sq. in.	149.4	148.4
Steam pressure at the turbine—pounds per sq. in.	144.7	144.6
Pressure in the calorimeter—pounds per sq. in.	1.36	1.38
Temperature in the calorimeter—deg. F.	294.8	300.2
Moisture in steam at turbine—per cent.	0.66	0.35
Vacuum in exhaust chamber—in. .	29.33	28.69
Temperature of steam in exhaust pipe—deg. F.	60.3	61.9
Water Pressures.		
Suction pressure as read—pounds per sq. in.	0.89	1.19
Delivery pressure near suction pipe level—pounds per sq. in.	107.34	107.97
Difference of gauge levels reduced to—pounds per sq. in.	0.79	0.40
Net pressure produced by pump—pounds per sq. in.	107.24	107.18
Net pressure specified—pounds per sq. in.	107.0	107.0
Quantity of Water Pumped.		
Size of Venturi meter tube—in. ...	21 x 36	21 x 36
Average manometer reading—in. mercury	4.895	4.99
Corresponding discharge—millions of Imp. gals. per 24 hours....	24.86	25.10
Specified discharge—millions of Imp. gals. per 24 hours......	24.00	24.00
Dial on recorder gave—millions of Imp. gals. per 24 hours	24.80	24.99
Speeds.		
Average pump speed—r.p.m.	582.6	574.8
Corresp'ding turbine speed—r.p.m.	3,478	3,431
Average air pump speed—r.p.m. ..	151	147
Feed pump speed, double strokes each plunger	66	47
Water Horse Power.		
Net pressure produced by pump—pounds per sq. in.	107.24	107.18
Discharge—million Imp. gals. per 24 hours	24.86	25.10
Work done per hour—foot-pounds:		
Westerly unit .. 2,562,679,427		
Easterly unit .. 2,585,972,052		
Corresponding water horse-power.	1,294.3	1,306.0
Steam Used per Hour.		
Steam condensed during test, including drips—pounds	169,803.5	168,010.0
Steam used per hour—pounds	16,980.3	16,801.0
Steam used per water horse-power hour—pounds	13.14	12.88

Duty.	Westerly unit.	Easterly unit.
Work done per hour—foot-pounds:		
Westerly unit .. 2,562,679,427		
Easterly unit .. 2,585,972,052		
Steam used per hour—pounds	16,980.3	16,801.0
Duty obtained—millions of foot-pounds of work per 1,000 pounds steam used	150.92	153.92
Duty specified	141.5	141.5
Amount that the unit exceeded the guarantee under specified conditions—millions of ft.-pounds	9.42	12.42

CANADIAN ENGINEERS BLEW UP HILL 60.

In a special dispatch from the Front, the Toronto Evening Telegram a few days ago published the following item concerning the work of Canadian engineers:—

"Hill 60 went up in fine dust, and well it might, for 250 tons of aminol, an explosive four times as violent as dynamite, had been stored away beneath this hill, notable in the struggles which have been waged in the Ypres salient.

"The engineering operations were performed by No. 3 Tunnelling Company, Canadian Engineers. There were three tunnelling companies with the Canadian forces who held this front until last summer, when they were moved to the Somme front. So well did they do their work that, when the Canadian army moved south, the tunnelling companies were made Imperial army troops, and remained. The charges that yesterday blew up Hill 60 were placed as long ago as last October.

"How Canadian ingenuity and pluck 'beat the Hun' in the operations in this sector is a story that cannot be told until the war is over. Meantime, give credit to the men who, 25 to 120 feet below the earth's surface, stripped to the waist, dig and 'kick' their way in tunnels about 2½ by 4 feet toward the enemy line. Under Hill 60 they encountered blue clay, the hardest of all soil to get through. And if the tunnellers clash with an enemy party, they do it in the dark and with knives."

A reinforced concrete water tower recently completed at North Point, Ala., has an 80,000 gallon tank 30 ft. high and 22 ft. in diameter, supported on a single centre column 35 ft. in height. The column has an extended conical base to provide stable footing and is hollow, containing the supply and discharge pipes for the tank above.

The British Trade Commissioner in Australia (Mr. G. T. Milne) recently forwarded to the Board of Trade Department of Commercial Intelligence, London, England, an extract from the local press containing a report by the manager of the Tasmanian government hydro-electric undertakings concerning further projected schemes. In addition to the Great Lake and King River schemes, it is stated that others are likely to be put in hand. There will be no difficulty in developing on the West Coast itself all the power needed there, even if the demand grows much larger than is at present anticipated. Over 10,000 horse-power can be developed at Lake Rolleston, near Zeehan, and the Franklin River, and other possible sources of power are now being prospected. Later, when copper is cheaper, an inter-connecting wire may be run from the West Coast to the Great Lake. In the central plateau region several schemes, quite apart from the Great Lake, are now being inquired into. It is thought that 40,000 horse-power—possibly more—can be developed on the River Derwent; the works will probably be some distance below Lake St. Clair, which will serve as a reservoir. The Arthur Lakes are a source which seems well able to yield 40,000 to 50,000 horse-power.

LUBRICATION OF ROCK DRILLS.*

By Charles C. Phelps,
of the Ingersoll-Rand Co., New York City.

ROCK drills are generally regarded as the most "rough and ready" tools in use. They can withstand almost any abuse. As a consequence, many drill runners believe that any oil is good enough for lubricating a drill. While it is true that drills will run with almost any kind of oil, it is beyond question that the best results and the least repair costs are obtained only by employing lubricants especially suited to the service. For steam-operated drills a good quality heavy-body steam cylinder oil is generally found to be most suitable. For air-operated drills, the usual advice is to employ a light or medium-body oil of good quality; however, recent experiments have shown that liquid grease is much better suited for air-operated drills under many conditions of service. This lubricant has been used successfully with both hammer and piston drills, mounted and unmounted types. Liquid grease is particularly valuable for water machines, like the Leyner-Ingersoll, water jackhamer and water stopehamer, for the reason that it is not washed out by the water as readily as oil is.

Liquid grease is a substance that has the appearance of oil and flows similarly, but otherwise has the characteristics and properties of grease. It may be handled in an ordinary oil can and will flow freely through the automatic lubricators on drills. It is made by several of the oil companies. It would be impractical to list here all the various brands which are suitable for air-operated drills, but "I R X" Jackhamer and Stoper grease (Standard Oil Co.), No. 6 Keystone liquid grease (Keystone Lubricating Co.), and "B" absorbed oil (E. F. Houghton & Co.) have been found to give satisfactory results.

The method of feeding is fully as important as the kind of lubricant used. Insufficient lubrication results in slower drilling speed, power wasted in friction, and a more rapid wearing out of parts with consequent higher repair expense. Lubricating too liberally simply increases the oil bill without making any appreciable gain in the operation of the drill. Too often, the matter of lubrication is left to the discretion of the drill runner, who either feeds the oil too liberally or forgets to replenish the supply until the drill runs dry and, by its poor performance, reminds him that it is time to relubricate. One of the best ways to determine whether a hammer drill is getting sufficient lubricant is to notice, when changing steels, whether the shank has oil on it. An operator soon learns to tell when a drill needs lubricant by the dry appearance of the steel shank.

The more modern drills are provided with means for automatic lubrication—features of the greatest practical value. Sometimes the oiling device is an integral part of the drill, and sometimes it is a separate part.

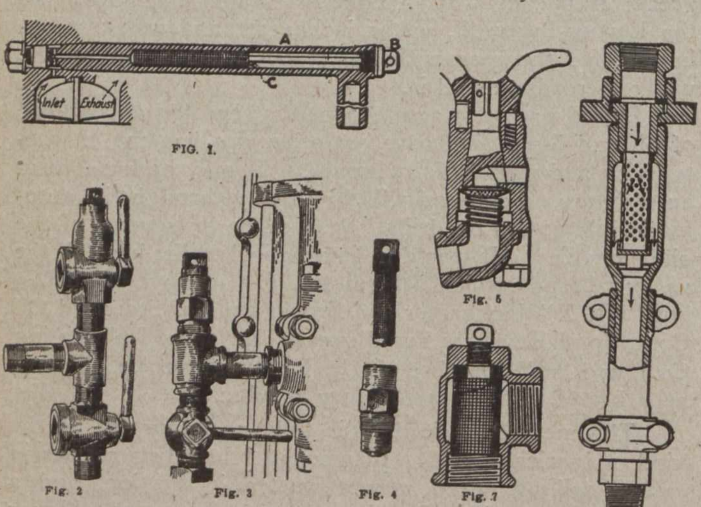
Fig. 1 shows the arrangement for oiling employed with a typical stoping drill. The oil well is in the handle used for rotating the stoper. The hollow handle *A* fits in a taper hole in the valve chest. In the handle is a porous plug *C*, beyond which is the oil chamber. Before starting the machine, oil plug *B* is removed and the chamber in the handle filled with liquid grease. As the machine runs, the pulsations of the air in the supply chamber of the chest draw the oil through the porous plug into the machine. Means are provided to exhaust any pressure in the handle after the air is shut off without

*From "Engineering and Mining Journal," New York.

drawing the oil out of the chamber. The porous plug serves the double purpose of regulating the flow of oil and straining out any dirt or grit it may contain. A somewhat similar arrangement is used with jackhamers, but in these drills the oil chamber is placed in the side of the cylinder.

If a drill does not embody an oiling device as an integral part of its construction, it can be fitted easily with a special oiler, of which there are several types on the market. In fact, many modern drills are designed to be used with oilers of the external type.

Fig. 2 shows a satisfactory type of external oiler which embodies an oil reservoir of about a half-pint capacity. It is made of malleable iron with a taper plug valve, and is intended for use with either air or steam-operated piston drills. The reservoir is closed with a screw plug. The taper plug has two cups on opposite sides, each holding about a teaspoonful of oil. One cup is always in communication with the reservoir and filled. A half-turn of the handle empties this cup into the supply passage to the drill, and the oil is carried as a spray into the machine. The other cup is filled ready for another



Rock Drill Lubricating Appliances.

Fig. 1—Handle of a stoping drill used as an oil reservoir. Figs. 2, 3 and 4—External oiler and lubricating cartridge. Figs. 5, 6 and 7—Three types of oil strainers in use with water drills.

turn of the handle. The reservoir holds enough oil for a half-shift's run, and the handle should be thrown about every 5 to 10 ft. of drilling. The right amount of oil is admitted each time, with no loss of oil or pressure.

Another type of oiler, Fig. 3, is designed to take the responsibility for proper drill lubrication out of the hands of the runner and place it entirely in those of the foreman. It operates by the pulsations of air in the supply pipe near the drill, due to the alternating reversals of the drill piston, and from the nature of its operation has been aptly named the "Heart Beat" oiler. It consists of an oiler body containing a plug carrying a cartridge of wire gauze and an absorbent material (Fig. 4). The body is screwed into a tee, to the branch of which the drill is connected, the oiler coming above the tee and the throttle.

The cartridges are carried in boxes. Three cartridges will suffice for one shift. The drill runner going on shift gets three cartridges from the foreman, and coming off shift, he returns three dry cartridges, which are dropped in a tub of oil and recharged. There is no way of drying the cartridges except by using them in the drill, and the return of dry cartridges is proof the drill has been properly oiled. The oil is not wasted—blown out without doing useful work—but is fed slowly and used to best advantage.

The "Heart Beat" oiler not only enforces proper lubrication of the drill, thus reducing its wear and increasing its capacity, but also economizes lubricant. This type of oiler is intended only for use with air-operated piston drills.

Sometimes drill runners introduce oil through the hose, pouring it in before connecting the drill line to the pressure main, thereby saving themselves the trouble of unscrewing the oil plugs of the drill. This practice cannot be condemned too emphatically, for the oil rapidly destroys the rubber lining used in ordinary hose, and furthermore, it carries into the drill any particles of dirt that may have lodged in the hose.

The remaining important point to be considered in connection with lubrication pertains to grit, dirt and other foreign matter. It is scarcely necessary to mention that the working parts of the drill should be cleaned frequently, preferably with kerosene, and kept well oiled or greased while standing idle.

Dirt must be prevented from entering the drill either with the lubricant or with the compressed air. The former point is taken care of by using a good quality of liquid grease only or oil free from impurities and keeping the supply in a closed vessel. A little grit will do a lot of damage in cutting out cylinders, valves and rotation parts. Small particles of grit and dust pass through the hose, and these must be removed before entering the drill, usually, by an air strainer or filter of some type placed as close to the drill inlet as practicable.

Fig. 5 shows the details of a strainer placed within a stoping drill. This strainer consists of a cup-shaped disk of perforated metal held in position back of the throttle valve by a coiled spring. It has been objected by some that a strainer such as this will result in loss of air pressure. However, tests at various pressures have shown that no reduction in air consumption or loss of power occurs through its use. If the work done by the machine falls off, it is an indication that the strainer is clogged with dirt and needs cleaning. It will be noticed that the air inlet is enlarged at the strainer, permitting an unrestricted flow of air.

Fig. 6 shows another type of strainer, which is principally intended for use on stope drills. The straining medium consists of a piece of perforated metal rolled into the form of a tube. The connection of which this type of strainer is a part should always remain attached to the valve chest when the machine is disconnected from the pressure line to prevent dust from entering the tool while lying idle. Dirt collects on the inside of the straining tube and may be easily removed from time to time by taking the device off the drill and blowing air through it from the end opposite that into which air ordinarily enters. Fig. 7 shows a sectional view of an angle filter, which forms a part of the standard equipment of certain water drills.

The straining medium in the filter illustrated in Fig. 7 consists of a tube of brass wire cloth through which the air must pass to enter the machine. The area through this tube is greatly in excess of the area of the inlet and outlet passages, which insures a free flow of air.

The production of graphite in the island of Madagascar, in 1915, amounted to 15,000 tons, compared with 8,000 tons in 1914, 6,319 tons in 1913, and 1,500 tons in 1911. Because of the large demand for this mineral in France and England, the local government has called upon the producers throughout the island to increase their output, and it is believed that the production for 1916 greatly exceeded 20,000 tons.

OUR WAR PROBLEMS.

(*Continued from page 518.*)

any other country on the face of the globe. We have some 35,000 miles of railway for a population of about eight million people.

A most interesting and valuable report on this problem was prepared by Mr. W. F. Tye, one of our members, who is also a member of the American Society of Civil Engineers. He presented his report in the shape of a paper read before one of the semi-monthly meetings of the Canadian society at Montreal. We did with it as we do with all of our papers,—printed it and distributed three or four thousand copies to our members, in addition to which Mr. Tye himself had printed and distributed about three thousand copies; so that as a result, before this debate comes off in parliament the people as a whole will have been well informed as to the existing conditions in regard to our railways and as to the possible methods of solution suggested through this paper.

Engineers in Canada have been called upon to advise and take certain part in the solution of many of the great war problems that we are now facing.

When we speak of Canada as it is to-day and of Canada as we hope it will be in the near future, it is impossible to disassociate the subject from Canada's part in the war, and as your chairman has seen fit to include my name in the program to speak on "War problems," I would like to approach the subject in that way, and particularly from the standpoint of the part which has been played by Canada.

War to-day is a matter of science. We can all look back to the times when we grumbled a great deal at being forced to read the history of how certain of the ancient armies went out to battle each other with battle-axe or broad-sword, or following on down through the more modern stories of war, but none of our studies have given us any appreciation of the change which has taken place in the conduct of war in the last few years.

The appliances used in connection with war nowadays are wholly a matter of engineering science. Whether it is a question of air-craft, submarines, high explosives, guns, projectiles, rifles, "tanks," or motor power, or particular kind of trenches and protective works; through the whole list you will notice that the engineering profession in some branch comes into play. Beginning with high explosives, you know the change which has taken place through the investigations of chemical engineers, until to-day the explosives used in warfare differ entirely from those used fifty years ago.

In the matter of guns: to-day the methods used in manufacturing guns (I mean when I speak of "guns," of course, artillery), are based upon different principles, and their use is entirely different from previous wars. Our modern rifles are entirely different and hundreds of new mechanical appliances are being used, so that it may be claimed that war to-day brings into play a greater number of engineering activities than was ever dreamed of in past wars. As a consequence, throughout all the armies of all the warring nations the engineer is playing a very prominent part.

As president of the Canadian Society of Civil Engineers, I am proud of the fact that we are putting up in our home building a roll of honor of the men in the engineering society in Canada who have gone to the front. That roll will comprise over 700 names. We are putting it up in the main hall of our building with a proper inscription, containing the name and rank of every man who responded to the call. Unfortunately, already we are having to signify many of the names on that roll with a golden star, showing that these men have made the supreme sacrifice for the good of the country and their profession.

When we came to the great demand for guns and munitions resulting from the changed method of warfare, very few people knew anything about it outside of Germany or France. Great Britain knew little about it and on this continent we knew nothing about it. You have in the United States, government arsenals that make munitions for your own guns, but they were not the character of munitions used in Europe. They would have been useless in the character of campaigns carried on there now, and therefore both in the United States and Canada in the effort to meet the demand it was necessary to originate entirely new methods, and the success met with is largely due to the way in which the mechanical engineers responded to the call, and took charge very largely of the installations in the munition plants which sprang up almost over night. As a result, in Canada to-day we have some four hundred thousand people engaged in the manufacture of munitions, largely of explosive munitions. We have had to create an entirely new equipment, but we have been able to get to that stage that with the marvelous expansion in Great Britain in the same lines, it looks as if in the near future we will be able to manufacture most of our own munitions. May I suggest to you, gentlemen, that the mechanical, civil and chemical engineering societies of the United States should put their services to-day at the call of your government?

In conclusion, gentlemen, the attempt to speak to you of the war problems is, of course, a very big undertaking. I have only in a very disconnected way attempted to tell how the profession that we are all proud to belong to has played its part. Some of the most important actual service done by men at the front has been done by men of the engineering profession.

Finally, I would say to you that the war is bound to affect you as it has us. It is bound to affect you as citizens; it is bound to affect your profession. There is no doubt but that following the war there is going to be a great demand for engineering experience the world over. Great Britain has suffered an immense loss in men, ships, material and wealth, but her shores have not been invaded nor are they likely to be. On the continent of Europe, the destruction is beyond human comprehension; and in connection with rehabilitation of these countries, engineers will be greatly in demand. In Russia, the opportunities after the war are going to be very marked. Russia is a marvelous country. The new government will probably follow a much more progressive policy and do much to extend the development of that country. There are Russian commissions now looking after industrial construction, dock installation, elevator construction, along the most detailed lines of costs, and supplies of material, which, if carried out, will involve an expenditure of many million dollars. Then, in France and Belgium there will be great openings for engineers, and it is reasonable to suppose that the engineering professions of the country who take part in the war will have the first call. We think that the men of the engineering profession in Canada who responded to the call of duty are going to have the first call in a professional way in the rehabilitation of these countries.

The largest octagon ingot mould which has ever been cast in America, and perhaps in the world, has recently been made by the Bethlehem Steel Company. It is said to weigh nearly 140 tons.

MANUFACTURERS DISCUSS RAILWAYS.

The necessity for additional railway equipment was brought strongly before the annual meeting of the Manufacturers' Association in Winnipeg last week by the report of the transportation committee. Attention was called to the recommendation of A. H. Smith, president of the New York Central Railroad, in the minority report of the railway commission, that the government should undertake at once to provide for an ample supply of freight cars and locomotives against immediate and imperative needs. The committee urged that the convention should make some representations to that effect to the government.

The valuable work done by the committee in connection with freight rates and other railway matters of prime importance to manufacturers was set out at length in the report. Commenting on the findings of the Royal Commission appointed to inquire into railways and transportation in Canada, the committee emphasized the unnecessary duplication of railway lines and facilities throughout the country and contended that legislation was absolutely necessary to guard against such evils in the future and to protect investments already made.

U.S. GOVERNMENT WILL BUILD ARMY TOWNS.

The training camps for the United States army will be complete small cities. Each will cover an area of 720 acres, will contain some 2,000 buildings, water supply and sewerage systems and roads. All will be built by contract. Most of the buildings will be long one-story structures of wood. The contractors will organize their own forces, but the building will be under the direction of army officers. Sites for the camps are now being selected and plans are ready for awarding contracts as fast as camp sites are chosen. Col. I. W. Littell, of the Quartermaster Grounds Division has been placed in general charge of cantonment construction.

CANADIAN ELECTRICAL ASSOCIATION.

The 27th annual meeting of the Association was held at the Ritz-Carlton Hotel on June 7th and 8th. According to statements made, Montreal has the cheapest electrical power of any industrial centre in America, this being due to the fact that there is an abundance of water power near the city.

A paper on "Electro Chemical Products" was read by H. E. Howe, and another on "Energy Distribution, Present and Prospective," by Julian C. Smith, Vice-President and Chief Engineer, Shawinigan Water & Power Co.

TORONTO ENGINEERS VISIT CAMP BORDEN.

About thirty members of the Toronto Engineers' Club motored to Camp Borden on Tuesday, June 12th. The start was made from the corner of St. Clair Avenue and Yonge Street about 8.30 a.m. Upon reaching the Camp the party was escorted by members of the Flying Corps, during an inspection of the hangars and aeroplanes. Lunch was served in the officers' mess. The party left Camp Borden about 6 o'clock and reached Toronto about 10 o'clock after a most enjoyable day's outing.

It was stated during the last annual meeting of the Canadian Electric Railway Association that on June 13th, 1916, there were 1,417.62 miles of privately-owned electric railways in Canada.

Reports of recent meetings of the Channel Tunnel Company indicate that the British government will likely decide that the much discussed tube connecting Great Britain and France shall be built. There have been repeated rumors recently that the decision would be favorable. At the meeting Baron Derlanger declared that some move must be made soon one way or the other, for railways preparing to rebuild the portions of their line on the Channel coast must know where the tunnel would begin on the English side.

DOMINION STEEL CORPORATION'S REPORT.

The net earnings of the Dominion Steel Corporation for the year ended March 31st, 1917, were $12,967,874, as compared with $7,004,316 for 1916. After adding $3,000,000 to a special reserve, and paying all charges and divdends, a balance of $6,038,182 is carried forward at credit of profit and loss.

The balance sheet shows current and working assets at the end of the year as $15,446,396. These included $4,858,167 in cash and $1,085,671 in war loans. The only current liabilities to set against them were $1,572,530 in ordinary trade accounts payable, wages, etc.; $246,731 for interest accrued on bonds, and $495,977 for dividends declared, payable after the close of the company's year—a total in all of $2,315,238. Total assets amount to $83,526,822.

President Mark Workman in the report states as follows: "The aggregate reduction in the funded and mortgage debts of the corporation and the constituent companies during the year was $5,501,709. The most important measures for extension and improvement are the construction of two batteries of Koppers By-Product Coke Ovens and extensive development of the iron ore mines in Newfoundland, both of which will strengthen the position of the corporation in respect to the output of iron and steel. The production of all the coal company's collieries was considerably below that of recent years, amounting to 4,279,772 tons, against 5,261,198 in 1916, 4,550,512 in 1915, 5,047,683 in 1914, and 5,051,603 in 1913. The causes of this falling off were beyond the control of the directors, arising for the most part from the scarcity of men consequent upon enlistment for service overseas, and also to a considerable extent from the lack of adequate transportation facilities."

New records were made by the steel company. The tonnage of pig iron produced exceeds the output in any previous year; as also does the output of steel ingots. The following table gives the annual production of the principal classes of iron and steel materials in the last two years:—

	Year ended Mar. 31, 1917.	Year ended Mar. 31, 1916
Pig iron	346,926	329,664
Steel ingots	377,079	371,086
Bloom and billets for sale	144,051	142,282
Rails	17,495	35,197
Wire rods for sale	67,492	55,106
Bars	5,259	8,017
*Wire	35,142	36,058
Nails	20,175	19,262

*This includes wire used in manufacture of nails shown in next line.

PARSONS FAVORS NATIONALIZATION.

That the railways in Canada should be nationalized was the contention of Mr. S. R. Parsons, vice-president of the Canadian Manufacturers' Association, when addressing the Hamilton branch recently. Five years ago, he said, he was opposed to such a project. He now believed that the nationalization of railways was a measure that would prove productive of much good. Since the outbreak of war the demagogue and the demagogue's regime was over, and only big men would be able now to secure seats in parliament—men big enough to operate successfully the railways of this country.

Mr. Cyrus A. Birge, in moving a vote of thanks to Mr. Parsons, said he did not favor the nationalization of railways. He had never heard of a country that was successful in managing its own railways, nor did he think he ever would.

Mr. T. S. Dickson, of William Beardmore & Company, shipbuilders, Glasgow, is in this country for the purpose of selecting a site for an extensive steel shipbuilding and dry dock plant. It has been definitely settled that a plant will be built in Canada. In company with Mr. A. D. Swan, consulting engineer, Montreal, Mr. Dickson has inspected sites at Montreal, Quebec, Halifax, N.S., and St. John, N.B.

Editorials

LAKE OF THE WOODS LEVEL.

From the summaries which have been given out simultaneously at Ottawa and Washington of the final report of the International Joint Commission, the problem of the proper level for the Lake of the Woods appears to have been settled in a manner most satisfactory to Canadian engineering interests. The commissioners have recognized that the dominant interests in that region are those relating to hydro-electric power.

The level set by the commission—from 1,056 to 1,062.5, sea-level datum,—is a higher level than that desired by the farmers bordering the lake, and means that the lake primarily will be used as a storage reservoir for the Winnipeg River and other water powers. The highest known level previous to 1916, as shown by the rocks around the lake, was 1,062, sea-level datum. This is higher than any level reached since 1892, the year when the levels were first taken and reported. In the spring of 1916, the lake reached 1,064 for a short period, but that flood was unusual and not likely to recur very often.

The maximum established by the commission is therefore within 0.1 ft. of the highest known level with the exception of last year's flood, and is higher than any level reached since 1892. This means that the importance of the development of power has been fully recognized. The farmers whose lands will be flooded will be compensated by cash payments.

One of the questions incidental to establishing a proper level for the Lake of the Woods, and one which for a time threatened to overshadow the main problem itself, was in regard to the control of the Norman Dam. This was a matter which involved principle and public policy and which necessarily had to be considered by the commissioners of the respective countries upon national as well as international grounds.

The question was whether there should be Canadian or international control of the Norman Dam,—a structure on the Winnipeg River which, while wholly in Canada and some sixty miles to the north of the international border, has a bearing upon international problems because it is the chief means of controlling the level of the Lake of the Woods.

This question has been most satisfactorily settled by naming 1,061.25, sea-level datum, as the ordinary maximum stage. So long as this height is not exceeded, control remains with the Ontario government, co-operating with the Dominion government. But should the water rise above the ordinary maximum or fall below 1,056, it is deemed that international interests would be affected and control then would be temporarily exercised by the International Joint Commission.

POLITICS AND BUSINESS.

The secrets of the political rules and regulations are confined to the select few. They have helped to prevent a coalition government. Yet strong opinion, thinking independently of parties, favors a national business government. Should Sir Robert Borden reconstruct his cabinet, choosing men of business ability for that reason and not for party reasons, the country will support him. Only professional politicians, who have been trained to look at everything from the partisan viewpoint, will protest against the breaking of ancient precedents at Ottawa. A determined effort to utilize all the available energy, money, brains and material, irrespective of party leaning, will have the country's approval.

Our people desire the nation's affairs and its part in the war conducted as large, enterprising corporations carry on their work. The Canadian Pacific Railway, the T. Eaton Company and other such institutions appoint their directors and executives with a view to getting the best results and to giving good service in the shortest time and with the least possible expenditure. These days of crises demand that governments should adopt the best business methods in the work of their administrations.

CANADA'S FUEL COMMISSIONER.

Members of the Canadian Society of Civil Engineers will be much gratified that one of their number has been selected by the government for the responsible position of fuel commissioner for Canada. Charles Alexander Magrath, D.T.S., M.Can.Soc.C.E., was born at North Augusta, Ont., in 1860. From 1878 to 1882 he was assistant on base lines, principal meridians and astronomical surveys for the Dominion Government. From 1882 to 1885 he was in charge of the government astronomical surveys. In 1885 Mr. Magrath left the employ of the government and became engineer for the Northwestern Coal & Navigation Co., and later on manager of the company's irrigation developments. After 21 years' connection with that firm, he was elected a member of the Dominion Parliament, and in 1911 became one of the three Canadian commissioners on the International Joint Commission. In 1915 he was elected chairman of the International Joint Commission, which important post he still occupies. Last week he was named by Premier Borden as fuel commissioner for Canada, with full authority to regulate sales and distribution of fuel throughout the country.

It is perhaps unusual to relate a biography editorially, but the circumstances deserve unusual treatment, because it is most unusual for any Canadian government, either liberal or conservative, to recognize an engineer for an important government appointment of this character, involving a high degree of executive skill and diplomacy. Mr. Magrath has shown a most satisfactory record and this should be an incentive to the government to try some more civil engineers for similar positions. His broadmindedness and far-sightedness are general characteristics of all engineers perhaps to a greater extent than applies to any other body of professional men. His resourcefulness and energetic method of getting things done thoroughly without undue delay is also typical of all the successful engineers. Premier Borden could find more C. A. Magraths among the members of the Canadian Society of Civil Engineers if he cared but to look for them.

The attitude of professional politicians toward engineers is well exemplified by the fact that one well-known member of parliament thought it necessary to apologize to his fellow statesmen in 1911 for the selection of an engineer as a member of the International Joint Commission, saying that Mr. Magrath was appointed "because of his keen, judicial mind."

1 Sheet missing torn by Department

PERSONALS.

Gunner J. DONALD McFARLAND BEATTIE, of Montreal, a graduate in Applied Science of McGill University, was wounded in the arm by gun shot on May 28th, and is now reported to be convalescing in a hospital in England.

S. B. BENNETT, formerly municipal engineer of South Vancouver, has been appointed principal of engineering and allied trades at the Winnipeg college for returned soldiers.

Lieut. FRED CLARKE, engineer and contractor, who has been connected with Grant, Smith & Co., of Vancouver, for the past few years, is organizing a railroad construction draft for overseas duty.

V. H. EMERY, formerly underground superintendent of the Hollinger gold mines, Timmins, Ont., has obtained a commission as lieutenant in the Royal Canadian Engineers.

CHARLES B. GORDON, vice-chairman of the Imperial Munitions Board, has resigned his position to become attached to Lord Northcliffe's mission to the United States. He will act there as representative of the British minister of munitions.

F. P. GUTELIUS, Jr., son of F. P. Gutelius, formerly general manager of the Canadian Government Railways, Moncton, N.B., was graduated from Lafayette College, Easton, Pa., on June 11th, and received his degree in Civil Engineering in absentia. He is now in the Canadian army.

HERBERT JOHNSTON, A.M.Can.Soc.C.E., formerly city engineer of Kitchener, Ont., has commenced practice in Kitchener as a consulting engineer.

SAMUEL KING, of London, Ont., has been appointed managing-director of the National Steel Car Co., Limited, of Hamilton, Ont., in place of BASIL MAGOR, who recently resigned. T. O. SCOTT, formerly secretary of the Canadian Tungsten Lamp Co., of Hamilton, has been appointed secretary-treasurer.

R. W. KNIGHT has severed his connection with the Standard Steel Construction Co., Welland, Ont., and will soon return to the United States.

Brigadier-General F. O. W. LOOMIS, of D. G. Loomis & Sons, contractors, Montreal, and Major E. G. M. CAPE, president of E. G. M. Cape, Limited, contractors, Montreal, are among the Canadian officers' names submitted by Sir Douglas Haig as deserving of special mention. Both officers were also included in the King's birthday honors. Brigadier-General Loomis has been made a C.M.G. and Major Cape has been awarded the D.S.O.

S. R. PARSONS, of Toronto, president of the British-American Oil Co., Limited, and of the Toronto Iron Works, has been elected president of the Canadian Manufacturers' Association for the next twelve months.

Sir WILLIAM D. REID, president of the Reid-Newfoundland Railway, and J. K. L. ROSS, a director of the C.P.R., have been elected directors of the Dominion Steel Corporation.

Hon. P. J. VENIOTA, minister of public works of New Brunswick, is ill in a Fredericton hospital.

FREDERICK S. VINEY, formerly with Westinghouse, Church, Kerr & Co., New York City, has assumed charge of the electrical department of F. R. J. MacPherson Co., Limited, Peterborough, Ont.

THOMAS WILLOUGHBY has been appointed chairman of the board of works, Owen Sound, Ont.

OBITUARIES.

SIR ALEXANDER R. BINNIE, an eminent engineer, died May 18th at Beer, Devon, England, in his 75th year. He was president of the Institute of Civil Engineers in 1905-6, president of the Institute of Municipal and County Engineers in 1897-8, and a member of the Royal Institute. He carried out important public work in India and held the position of chief engineer to the London County Council from 1890 to 1902. In February, 1913, along with Dr. A. C. Houston, of the London (England) Metropolitan Water Board, Sir Alexander visited Ottawa to report on an improved water supply for that city. Sir Alexander, after a thorough investigation of the conditions, recommended that the existing source of supply from the Ottawa River be abandoned and that what is known as the "Thirty-one Mile Lake Scheme" be adopted. This scheme met with the approval of the provincial board of health for Ontario, but the citizens voted against it and in consequence no further action has been taken.

SIR WILLIAM CHRISTOPHER MACDONALD, chancellor of McGill University, Montreal, died on June 9th after an illness extending over a period of three years. Sir William was born in Prince Edward Island in 1831. He was one of the eight honorary members of the Canadian Society of Civil Engineers, having been so elected on January 9th, 1896, on account of his outstanding assistance to the cause of engineering through McGill University. His aid in money to McGill totalled $10,690,165, a large portion of which comprised property, buildings and endowments for engineering, architectural and chemistry departments. Sir William Peterson, head of McGill University, often said that he was ashamed to go to Sir William Macdonald so often for money, but that the latter was always ready with open hand. Sir William Macdonald laid the foundations for his large fortune in the tobacco trade, and was long known as the "Tobacco King" of Canada. He had many interests and profitable investments aside from his own business, however.

JAMES WARREN, civil engineer and land surveyor, died at Walkerton, Ont., on June 11th, after a brief illness. Mr. Warren, who was in his 80th year, was born in the county of Halton, near Acton, and for many years was the official engineer for the counties of Halton and Bruce. In 1870, under contract with the Dominion government, he sub-divided into townships a section of the province of Manitoba, and in subsequent years performed a similar service in Saskatchewan and Alberta. His last contract was filled in 1910, when he sub-divided a section of Alberta lying among the foothills of the Rockies.

GEORGE A. STEWART, who was for some years city engineer of Calgary, Alta., passed away at his home in Victoria, B.C., on May 13th, at the age of 87 years. He was the fourth son of the late Hon. Thomas Alexander Stewart, and studied civil engineering under Sir Sanford Fleming, later assisting in the construction of the first railway built in Canada. He practised his profession at Port Hope until 1867 and was chief engineer of the Midland Railway from 1868 to 1877. A large wooden pontoon bridge built by Mr. Stewart, the first bridge of its kind erected in Canada in 1866, is still in service. For eleven years, from 1886, Mr. Stewart was in charge of the Rocky Mountain National Park, and later went to Calgary, where he resided a number of years and served as city engineer. He removed to Victoria about eight years ago, having retired from active practise of his profession. Mr. Stewart was a member of the Canadian Society of Civil Engineers.