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The Canadian Engineer

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CONSTRUCTION OF THE NEW QUEBEC BRIDGE

EVENTS LEADING UP TO THE PRESENT UNDERTAKING—NOTES ON THE COMPLETED MASONRY—ERECTION DETAILS AND POINTS OF SPECIAL INTEREST IN THE SUPERSTRUCTURE.

AT a meeting on February 25th, 1914, the Toronto branch of the Canadian Society of Civil Engineers was addressed by Mr. C. N. Monsarrat, Chairman and Chief Engineer, Board of Engineers, Quebec Bridge. On March 2nd, Mr. Monsarrat delivered a somewhat similar address before the Canadian Club of Montreal. His subject at each meeting was a description of the reconstruction of the new Quebec Bridge, and from his remarks the following synopsis is presented:

As early as 1852 a project for a bridge over the St. Lawrence River at Quebec was considered, and again in 1884 a design was prepared and submitted to the Quebec Board of Trade for a bridge at about the present site, but nothing actually was done until about 1900, when the Quebec Bridge and Railway Company located a site near Cap Rouge and took definite steps towards the erection of such a structure. This location is at the narrowest point on the St. Lawrence River between Montreal and Quebec, the width at mean water level being about 2,000 feet. The water at this point has a maximum depth of about 200 feet and a current at ebb tide of about 7 miles per hour. The Bridge and Railway Company awarded contracts in 1900 for a bridge of the cantilever type having a main span of 1,800 feet. Work was started and proceeded until the year 1907, when about half the superstructure, then erected, collapsed. Soon after this lamentable disaster the Dominion Government undertook to reconstruct the bridge, and in 1908 appointed a board of three engineers for that purpose. This board made very exhaustive studies of various designs, including suspension and cantilever bridges, and finally decided, for good and sufficient reasons, that the cantilever type of bridge was the most satisfactory and economical kind of structure for such a crossing. It also decided that the bridge should be much wider and designed for heavier loading than the former bridge, that the same length of main span should be retained and that it should be built at the same site. Several changes were made in the personnel of this Board during the progress of the work, and since the contracts were let the Board has been composed of Mr. Ralph Modjeski, Mr. C. C. Schneider and Mr. Monsarrat, who is chairman and chief engineer.

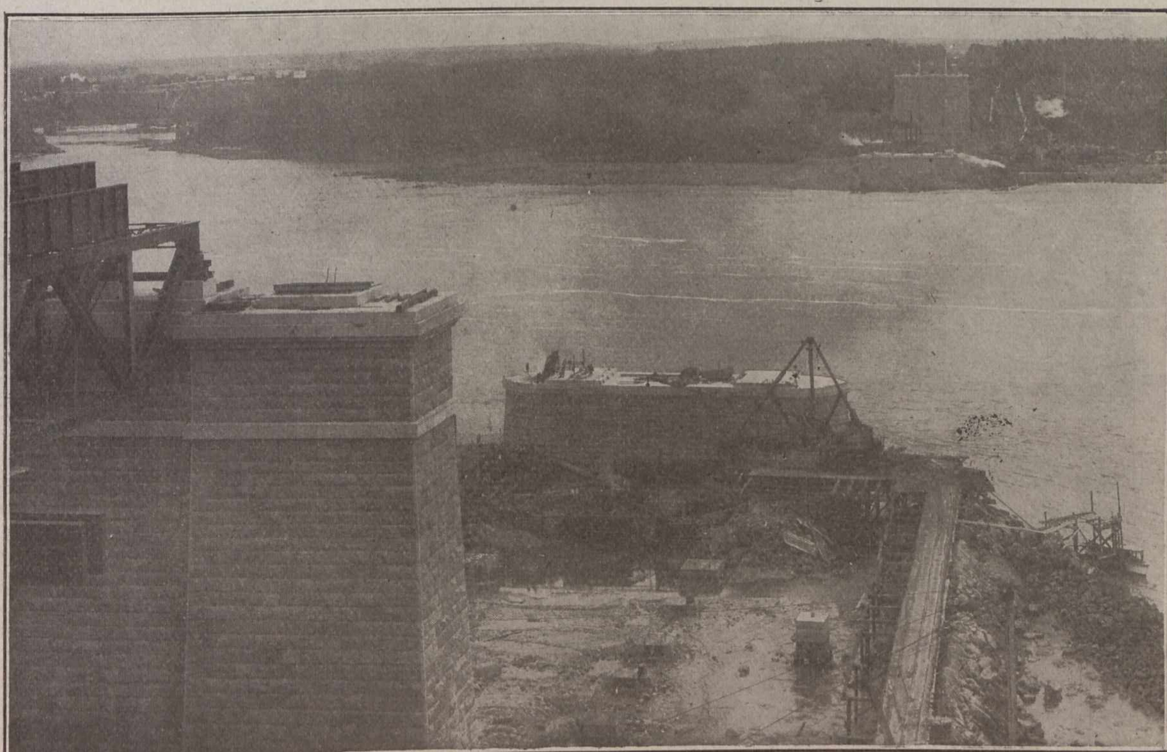

Fig. 1.—General view of the bridge site from the north shore, showing the completed masonry on both sides of the river.

Among the first things to be done in connection with the reconstruction was to take an extensive series of borings to ascertain the nature of the bottom and locate bed rock. The latter was found to exist about 100 feet below high-water. It was also decided that the old masonry was not large enough to suit the new structure and it was therefore demolished and entirely new piers built.

The clearing away of the debris of the fallen structure was a somewhat difficult task, but it was finally accomplished by the aid of the oxy-acetylene torch and dynamite. At the present time there is little or no evidence to show that this accident had ever happened. There still remains, however, about 10,000 tons of the old bridge at the bottom of the river extending out from the shore over 800 feet. Tied down by this wreckage are the remains of some 60 or 70 men who lost their lives when the accident took place. As the water at this point is very deep and the wreckage is far below the requirements of navigation, this steel will probably remain for all time in its present location, as there is no known method of salvage at the depth at which it lies.

The most serious problem in the construction of the masonry was the sinking of the pneumatic caissons for the two main piers. On the south side a single caisson 180 ft. x 55 ft. in area was used. On the north side two caissons each 80 ft. x 60 ft. were sunk with a 10-ft. space between them, the pier being bridged over this opening. No serious difficulty was met with in the sinking of these caissons although the material on the north shore was very much harder to penetrate than that of the south.

The completed main piers at the present time, extending as they do about 25 ft. above the water, do not give evidence of the enormous amount of labor expended in their construction. As the north pier was driven 60 ft. and the south pier 100 ft. below the bed of the river, at a cost of approximately $1,000,000 each, some idea of their enormous proportions may be obtained.

The anchor piers show up more prominently, being entirely above high-water. These piers are 136 ft. long and 29 ft. wide and extend about 140 ft. above the surface of the ground, or higher than a 10-story office building.

The span of the Quebec Bridge is 1,800 ft. between main piers—the longest of any bridge in the world—being 100 ft. longer than that of the famous Forth Bridge in Scotland. The length of the suspended span is 640 ft., and the total length between abutments, 3,239 ft. The bridge has a clear height of 150 ft. above extreme high-water for a distance of 700 ft. at the centre of the bridge, in order to allow passage of ocean ships beneath. The bridge is 88 ft. wide centre to centre of trusses, or 21 ft. wider than the old bridge. The height of the main posts over the main pier is 310 ft., with an unsupported length of 145 ft. These posts weigh 1,500 tons each, the four of them costing in the neighborhood of $1,000,000. The height of the bridge above the floor at the main piers is about 180 ft. Some idea of the enormous proportions of this bridge may be gathered from the fact that a 16-story building could rest on the floor at this point and hardly extend above the tops of the main posts.

The steel shoe or pedestal carrying the main posts and other members on the main pier has a base with an area of approximately 22 ft. x 26 ft. It is 19 ft. high and weighs about 400 tons. The total reaction on each of these shoes amounts to 55,000,000 lbs. Some idea of this enormous force may be gathered from the fact that it represents the weight of 150 standard locomotives. If these locomotives were placed one upon the other they would extend to a height 15 times that of an ordinary 10-story building.

The bottom chord of the bridge weighs approximately 400 tons between main panel points. This has to be shipped in four pieces for shipment and handling during erection. The outside dimension of this chord near the shoe is approximately 7 ft. x 10 ft. 6 in. If it were not for the interior diaphragms and bracings, it would be possible for six or seven men to walk abreast throughout the length of this member.

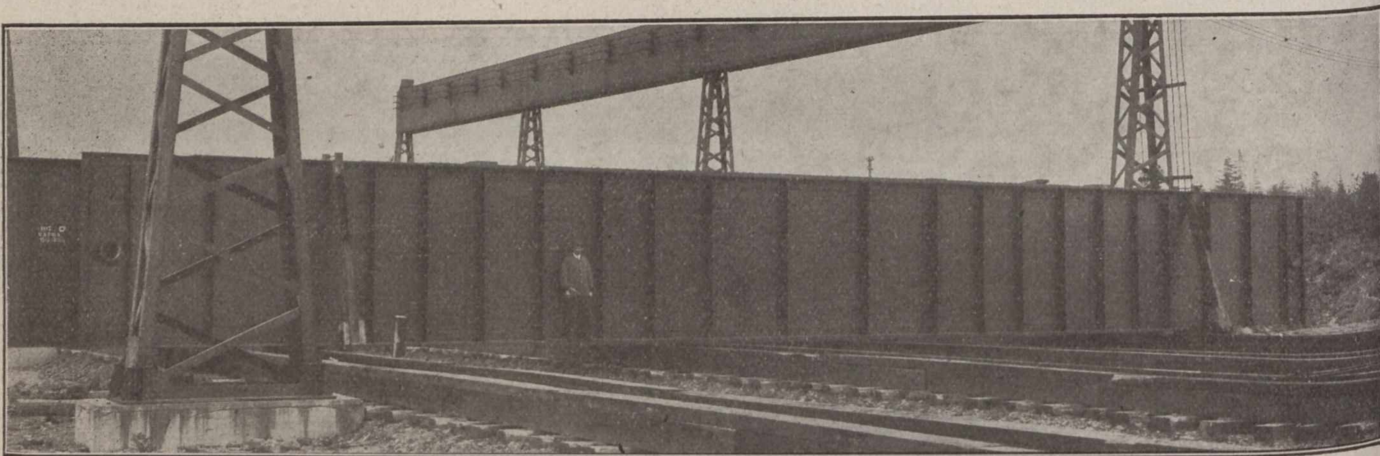

Fig. 2.—View showing one web of double floor beam at the bridge site storage yard. These girders are 10 ft. high and 88 ft. c. to c. 11-inch pins are used to connect the 60-ton floor beams to the post.

The main post, as stated before, is 310 ft. high. It is approximately 9 ft. x 10 ft. in outside dimensions, and has an area of 1,902 sq. in. It is composed of four columns laced together, and requires to be shipped in 27 pieces and connected together in the field. The weight of the bridge will amount to about 65,000 tons, which weight exceeds that of the 200 bridges constructed on the National Transcontinental Railway. These bridges, if placed end to end, would extend over a distance of 11 miles. This weight is also about five times that of the new double-track C.P.R. bridge over the St. Lawrence at Lachine.

A proportion of the steel used in the bridge will be nickel steel, 40 per cent. stronger than the ordinary carbon steel used in other bridges. This nickel steel is used principally near the centre of the bridge where the weight is the greatest factor in deciding the size of the members.

The bridge is designed to carry two railway tracks, capable of carrying two trains weighing approximately 5,000 lbs. per lineal foot each. There are also two sidewalks for foot passengers. No provision has been made for highway traffic.

New shops have been constructed by the St. Lawrence Bridge Company, exclusively for the manufacture of this bridge, with special equipment and handling machinery, the whole costing in the neighborhood of a million dollars.* Up to the present some 9,000 tons of material have been manufactured and shipped to the site.

During the past season the contractor for the superstructure has got his plant in shape and has already erected the two north approach spans from the abutments out to the anchor pier. It is expected that during the coming season practically the whole of the north anchor arm will be erected.

The erection of this bridge is probably one of the greatest problems, calling for more engineering skill than any other structure of its kind in the world. Every feature of erection from the placing of the members to the driving of the rivets is worked out in detail, and is supplied in printed form in a bound book to the erecting superintendent. All engineering problems are therefore solved for the erection force before they start, their duty being simply to carry out the mechanical end of the work in accordance with positive instructions. To handle the huge members on the bridge itself during erection, enormous steel travellers will be used, one on each side of the river, each of which, with its machinery, will weigh over 1,000 tons. One steel traveller is at the present time nearing completion on the north shore. All the cranes and derricks on this traveller are operated by electricity. The traveller runs on trucks and is moved from point to point on the floor of the bridge as the work progresses. This derrick is capable of lifting 55 tons on a boom 50 feet long. Everything about the mechanism and machinery has been made as nearly foolproof as possible.

In order that there may be no possibility of these heavy members being dropped and doing damage to the bridge or endangering lives, it is necessary to operate the hoisting engines against an electric resistance which means that the engines have to work just as hard to lower a piece as is necessary to raise it. Some idea of the size of the tackle used may be gained from the fact that the large blocks employed are about 5 feet in height, and weigh approximately 5,000 lbs. each.

One of the features of the erection which will probably be unique in the annals of bridge engineering will be the floating in of the centre or suspended span. This span will weigh about 5,000 tons and will be erected on trestles at some point near the bridge. When it is ready to be floated, very large pontoons will be floated under the span at low tide and when the tide rises will lift the entire span off the blocks. It will then be floated into position under the two ends of the cantilever arms at a low level and be connected up to these arms with long steel links. During this operation all navigation will be stopped in the river. When the connection has been made at the four corners at extreme high tide, the barges will settle with the tide and leave the span suspended. Powerful jacks of 2,000 tons capacity, situated at each corner of the cantilever arm, will then be brought into play and this span lifted slowly into place. It is estimated that

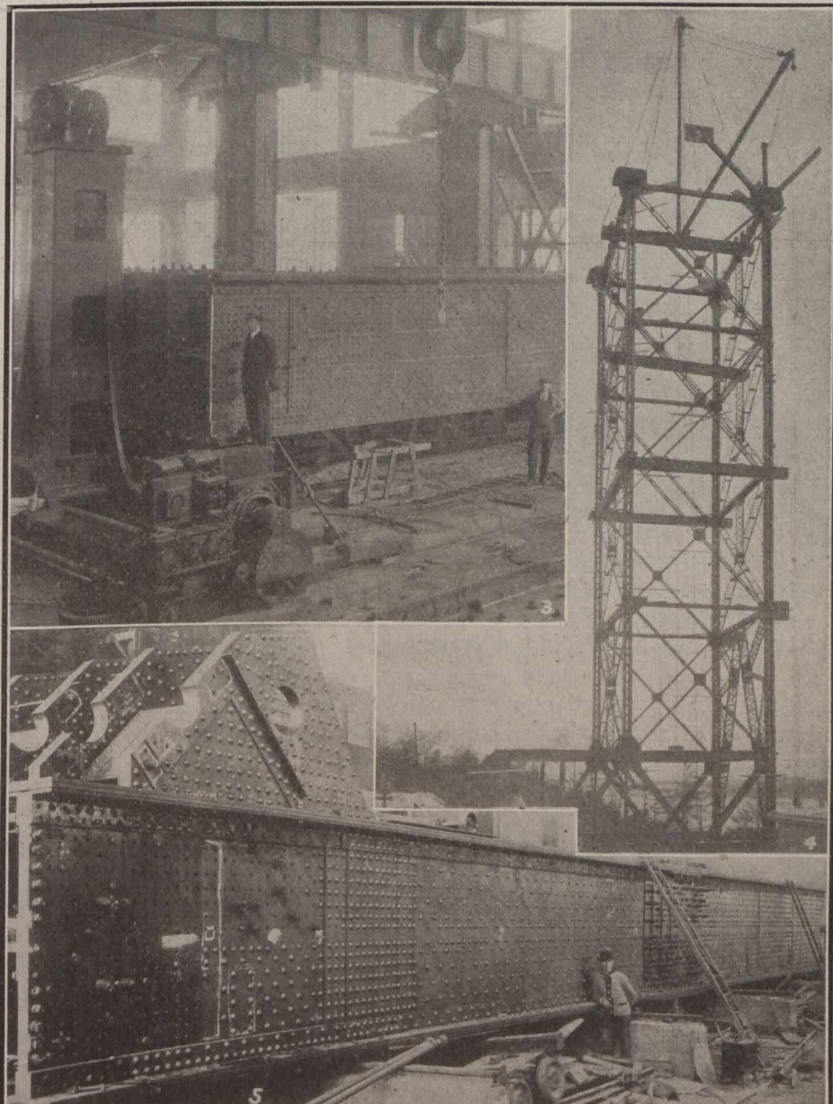

Fig. 3.—View of one end of main bottom chord in twin vertical facing machine which faces both ends simultaneously. This chord is a ½-panel length and is shipped in two pieces. Fig. 4.—North shore traveller in course of erection. It is 200 ft. high and will weigh over 1,000 tons. Fig. 5.—One full panel length connected up for the reaming of the splice plates. The member, as it stands, weighs 400 tons. The heavy gusset plates taking a vertical tension and diagonal compression member is shown at one end.

the connecting up of the span should not take over an hour under good conditions and the span itself should be lifted into its proper position in about 48 hours.

The erection of the suspended span in this manner will save about one year in the time required for the complete erection of the bridge.

It is expected that the bridge will be sufficiently completed to allow traffic to proceed over it by the end of 1917.

*For full description of these shops see *The Canadian Engineer* for January 22nd, 1914.

There are many interesting features worthy of note in the shops of the St. Lawrence Bridge Company, mentioned elsewhere. Among the accompanying illustrations

Fig. 6.—North approach span erected. As the railway tracks on the bridge are 32 ft. centre to centre, these approach spans are erected as two separate bridges, each carrying a track.

there are several which convey a slight idea of the size and weight of some of the bridge members which these shops are turning out. Their proportions greatly excel

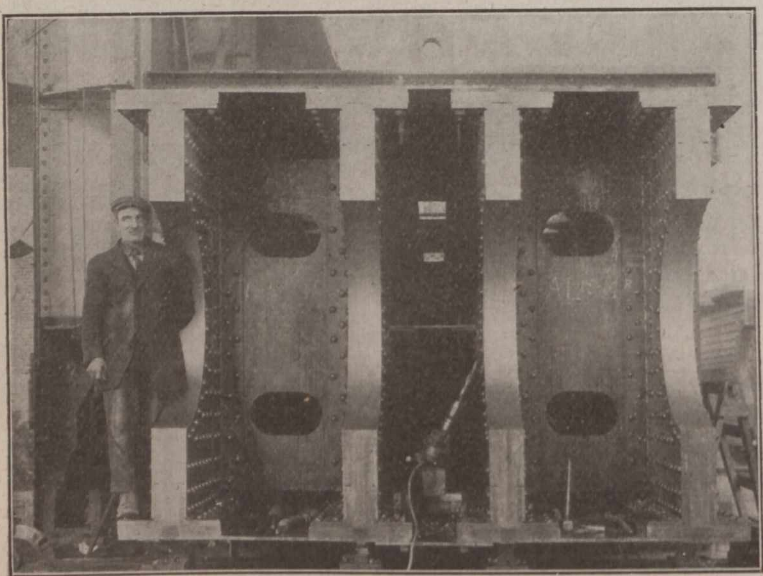

Fig. 7.—End view of member shown in facing machine. This end is bored for a 45-inch pin sleeve, which takes a 30-inch pin weighing 12 tons. Each of the webs are 7 inches thick at the pin. Manholes are provided at all diaphragms to allow contractors, painters, etc., to reach every portion of each member.

those of the product of any other shop removed any distance from the site. Moreover, the special machinery with which the plant is equipped for the rapid and accurate machining of special designs is in itself remarkable in its massiveness and adjustments. Among these various machines are the two planing machines, manufactured by James Bennie and Sons, Glasgow, with a capacity for plates up to 46 ft. in length. In them the heavy sheared plates have their edges finished, the cutting tools operating on both forward and return strokes.

The drilling and reaming are carried out on 16 stationary 7-foot radial drills, made by the Canadian Machinery Company, and 24 portable drills, transferred by cranes from one place to another. Shop rivetting is done for the most part by pneumatic yoke machines of 100 tons capacity.

A vertical boring mill manufactured by John Bertram and Sons Company, is used for boring large pin-holes and oval manholes. These large pin-holes, up to 4 ft. in diameter, are then finished in a horizontal boring machine with horizontal and vertical motions sufficient to permit the finishing of five of these pin-holes without resetting.

GRAND RIVER IMPROVEMENT.

SINCE the publication of the preliminary report of the Hydro-Electric Power Commission of Ontario on a proposed scheme or artificial storage and flood control on the Grand River, an exhaustive study of the flow characteristics of the river and its tributaries has been under way. The preliminary report appeared in *The Canadian Engineer* for April 17th, 1913. According to the 6th annual report of the Commission the investigation was begun in June, 1913, and at the present time gauging stations are established on the Grand River, and gauge recorders employed at each station to take readings of water level twice a day. This work has now been carried through one low-water season and some valuable information obtained. There has so far been a reasonably close relationship between gauge height and discharge. This satisfactory relationship has been mainly the result of low-water conditions, and there is unfortunately no likelihood that similar conditions will obtain during high stages of flow, when the gauges will be unavoidably affected by back-water.

In anticipation of the effect of back-water upon the gauges, a line of levels was run up the Grand River valley as far as Bellwood, and for several miles up each of the main tributaries. The work was started at Dunnville, using the U.S. Lake Survey level of Lake Erie as a datum. Permanent bench marks referred to sea level were established at convenient intervals on the main stream and tributaries.

During the course of the work all accessible Geodetic Survey bench marks were picked up, and in every case a very satisfactory check was obtained. A reasonable check was also obtained on various railway elevations.

All the gauges from which water level readings are being taken on the Grand River and tributaries are set from these bench marks, consequently all gauges are set to the same datum throughout the watershed, and slope data can be taken directly from the gauge readers' records. With the help of this slope data it is hoped that it may be possible to apply corrections to the gauge readings during high stages of flow, and thus eliminate to a large extent the effect of back-water.

THE MANAGEMENT OF SEWAGE DISPOSAL WORKS.

IN a paper which he read last month before the Institute of Sanitary Engineers at Westminster, Eng., Mr. John E. Farmer, engineer-in-charge of the sewage disposal works of the town of Croydon, presents the following notes on the operation of disposal works:

The works manager should look at the disposal of sewage in the light of a manufacturing process—the sewage discharged on to the works being the raw material and the final effluent the finished product. With regard to the financial aspect, a manufacturer must part with his finished product at a price that is greater than the cost of his raw material plus expenses of manufacture. With sewage disposal the raw material may be taken as being delivered to the works free of cost, and, there not being, except in a few cases, any saleable product, there is only the cost of manufacture of the final effluent to be taken into account.

There are two things to consider in the improvement of sedimentation tanks, i.e., the reduction of the amount of suspended matter in the tank effluent of the present designs, or to increase the volume now treated by the same tank capacity without increasing the solids in suspension, as now obtained. The former would lessen the work to be done by the process which follows, and the latter would save tank construction.

By placing a fine screen, such as 3/32 in. perforated zinc, between the tanks and the filters, it will save about three-quarters of the labor in cleaning the holes of the sprinklers, where such are in use, and also save much treading on the surface of the filter.

During a portion of the year there is some of the irrigation area fallow. The efficiency of fallow land is about one-third that of grass-cropped land where broad irrigation is the method; but where land filtration is in vogue the effect of a fallow period is not so great.

With an up-to-date plant for the purification of the liquid portion there are the solids to be dealt with; these have been a source of much trouble ever since sewage disposal was first put into operation.

The solids screened out and that deposited in the grit chambers are easier to deal with than the sludge, as they contain less moisture, and thereby more easily disposed of.

At Croydon all the solids are disposed of on the land—the screenings and grit by cart or trucks, the sludge by pumping—all being spread and ploughed in as manure. Lime is added to the sludge before pumping to reduce the smell and to accelerate the decomposition of the organic matter. The addition of 0.5 per cent. of lime reduces the smell about 75 per cent. The ratio of screenings and grit to sludge is 1 to 11.75, both in their wet state, or 1 to 2.8 in the dry state.

In the management of a sewage disposal plant, irrespective of the method of disposal, there should be kept records of all the different items showing the work done, thereby not only giving the present position, but enabling comparison with the past and information for the future.

The most valuable method of keeping the records is by diagrams. The usefulness of this method far outweighs the time and labor required to plot them, as the information for comparative purposes, so essential in tracing the cause and effect, which many times arises in the disposal of sewage, can be seen at a glance.

The main items for recording are: Volume of sewage and amount of rainfall; quality of sewage and effluents; amount of screenings, grit, and sludge; number of units working of the different parts of the process of purification; also the cost in wages, say, of the sludge disposal; irrigation; pumping, etc.

In keeping records there is obtained information that is of value not only to the management, but to the engineer in designing new extension works.

Combining the record of the hourly flow and the oxygen absorbed in four hours of samples taken each hour, one is able to find between which hours the greatest amount of impurity, as indicated by the above test, has to be dealt with.

Last, but not the least, item in the management of sewage disposal is the finding by observation and research the means of improvement in the present methods of purification, and also for the cause of the effect obtained.

Some work in this respect which I have done may be of some interest.

It has been known for years that a filter of fine-grade material gives better results in purification than one of coarse grade. Also some materials give better results than others. But there has not been, to my knowledge, any work done to definitely settle the cause of these differences.

One difficulty has been the want of means to measure the physical properties of the different materials used as a nidus for the bacteria. If this could be overcome, the point could be settled as to whether the cause of the difference between two different materials, when used as a nidus was due to greater absorptive powers of one than the other, or to greater surface area. The former used to be given as the reason by many a few years ago, but I think the latter is generally recognized as the reason at the present time.

To find the purification given by clinker as a nidus in a filter, as compared with gravel, a filter was constructed in two halves, one-half filled with clinker and the other half with gravel, in 1904, at Croydon.

The grading being the same for both materials, i.e., drainage tiles and 3 in. gravel = 9 in.; ¾ in. to 1 in. = 1 ft.; ¼ in. to ¾ in. = 3 ft. 3 in.; total, 5 ft. Area, 200 square yards; rate of working, 200 gallons per square yard per 24 hours. Fed by revolving sprinkler.

The average results of 31 samples taken between October 13th, 1904, and June 19th, 1905, are:—

	Tanks' Effluent.	Clinker ½.	Gravel ½.
Free ammonia as nitrogen..	5.747	0.665	4.148*
Albuminoid as nitrogen	0.360	0.068	0.166*
Oxygen absorbed, 4 hours..	4.157	0.914	1.843*
Chlorine	9.43	9.14	9.71*
Nitrates as nitrogen	—	4.529	1.265*
Nitrites as nitrogen	—	0.165	0.294*
Dissolved oxygen	—	5,8	4.4†

*Parts per 100,000. †C.C.S. per litre.

The above results show that clinker gives much better results than gravel; but the question is, What is the cause of this?

To find the reason, I have carried out some experiments in the laboratory.

As regards the reduction of the impurity by passing over the surface, there must be taken into consideration that as the water passes downwards it gradually becomes less impure, so that after passing over one surface area it gives to the next a water which has less impurity than it received, so it is quite obvious that the same per cent. purification cannot be effected by the second area of surface, assuming they have both the same surface area.

From the experiments made one comes to the conclusion that the surface area of the material is the factor which governs the comparison between one material and another as regards its suitability as a nidus in a filter.

It may not be out of place, especially as I have mentioned it before, to give the physical property of materials for absorbing salt. During my experiments to obtain a method for estimating the surface retention, I found that all materials experimented upon absorbed a considerable amount of salt, and by extending the surface retention method this absorption could be estimated.

The following is a summary of the results: That with both clinker and gravel the amount absorbed per cube foot increases regularly with increased diameter of the particles. If this property was the cause of the difference in purification, as many believed it was, the purification would increase with the increase in size of the material; but the reverse has been shown to be the case. The management, after obtaining an effluent, has to observe its effect on the stream into which it is discharged, and there is a great probability that in the near future this will be one of the management's most important observations.

MINERAL PRODUCTION IN QUEBEC FOR 1913..

Substance.	Production, 1913. Quantity.	Production, 1913. Value.	Value in 1912.
Asbestos, tons	136,195	$3,825,959	$3,059,084
Asbestic, tons	28,371	20,245	23,358
Copper and sulphur ore, tons	89,345	866,774	631,963
Feldspar, tons	74	1,554	2,200
Gold, oz.	738	14,794	19,924
Graphite, tons	103	9,620	50,680
Iron ore, bog, tons	......	......	......
Iron ore, titaniferous, tons	4,981	9,824	4,024
Kaolin, china clay	253	4,354	520
Magnesite	......	......	9,645
Mica, lbs.	781,648	117,038	99,463
Mineral water, gals.	77,313	31,728	39,854
Ocher, tons	5,987	40,868	32,010
Peat	......	......	2,000
Phosphate, tons	360	3,506	1,640
Quartz and Phonolith, tons	900	2,363	418
Silver, oz.	36,392	21,791	14,591
Zinc and lead ores, tons	335	7,370	......
Structural Materials.			
Brick (M)	156,358	1,272,092	1,284,232
Cement, barrels	2,881,480	3,361,292	3,098,350
Flagstone	......	......	600
Granite	......	482,338	358,749
Marble	......	120,541	252,041
Lime, bushels	1,656,610	452,330	455,570
Limestone	......	1,570,455	1,363,555
Sand	......	343,750	170,600
Sandstone	......	5,072	......
Slate, sq.	1,337	6,286	8,939
Tile, drain and sewer pipe, pottery, etc.	......	326,165	203,100
		$12,918,109	$11,187,110

There has been in recent years a steady increase in the amount of brick pavement laid in Rochester, last year a total being attained of 85,040 square yards. However, the amount of asphalt pavement is still greatly in excess of any other kind. In 1913, 146,524 square yards of street asphalt were laid, while 121,700 square yards of creosoted wood-block pavement were laid in Manhattan borough, 20,000 square yards in Peekskill, and much smaller quantities in other boroughs.

REPORT ON COLLECTION AND DISPOSAL OF WASTE, TORONTO.

THE Street Commissioner of the City of Toronto, Mr. Geo. B. Wilson, has recently presented a report on the collection and disposal of the city's refuse, together with a number of recommendations in connection therewith. The report has received the approval of the Medical Officer of Health for Toronto, and the Chief Health Officer of Ontario. In this report, it is assumed that the term refuse includes garbage, rubbish, and ashes; that the term garbage includes all kitchen refuse; and that the term rubbish includes all household waste other than ashes and garbage.

A summary is given as follows: It is recommended that the city construct a combined central plant at Ashbridge's Bay, where all garbage will be disposed of by the reduction process, and all rubbish incinerated in high-temperature furnaces. The power which is developed from the rubbish furnaces will be utilized in the reduction plant, and the gases deodorized.

An analysis of the studies made demonstrates that the disposal of garbage by reduction becomes more advantageous in future years, as compared with other methods of disposal.

The reduction method for the disposal of garbage requires a larger capital cost, but with all items considered, will require a much lower net annual cost.

All work contemplated will be developed on a comprehensive scale, and with reference to future needs.

The development of any method for collection and disposal of refuse should also consider all branches of work carried on by the street cleaning department, with special attention to operation and unit cost-keeping.

The equipment used in collection of refuse should be installed with special regard to work to be done, from the standpoint of sanitation and economy.

All refuse, so far as possible, should be removed from the premises (and not placed on the curb), so as to eliminate the unsightly appearance of streets on collection days.

In making separate collections of refuse, co-operation will be required on the part of the citizens, as well as the strict enforcement of regulations by the department of street cleaning.

It is recommended that the condition of the present stables, yards and shops should be remedied by the construction of adequate buildings, to enable the department to satisfactorily conduct all branches of the work.

Early action is desired, to relieve the present conditions.

The question of garbage and refuse disposal received considerable attention at the hands of Mr. R. C. Harris during the period in which the service was under his control. It was reported upon by him in 1912 and as a result a by-law was passed in January, 1913, authorizing the expenditure of $1,000,000. The matter remained in abeyance, however, until the reorganization of the present department in May, 1913. Since that time, Mr. George B. Wilson, Street Commissioner, realizing the importance of the step to be dealt with and the necessity of an early solution, has given the problem a thorough investigation. In October, 1913, he acquired the services of Mr. I. S. Osborn, an engineer experienced in the methods of collection and refuse disposal as practiced both in America and Europe. Since that time Mr. Osborne and his staff have prosecuted the necessary preliminary investigation without interruption.

The problem of waste disposal naturally involves, among other things, a complete study of the methods and costs of collection, the equipment required for such collection, and the population to be served in the different sections of the city at various periods. Recognizing that the solution of the refuse problem in itself would only afford a partial relief from the conditions which prevail throughout the city it was decided to include in the investigation a study of present stable, shop and yards requirements as well as studies of collection methods and equipment.

Concerning the methods of collection the report makes the following reference:

Collection Methods.—Great advance has in recent years been made in this manner of collecting waste in many of the European cities, and so far as possible, such changes as are to be made in the collection methods of the department, will be carried out with the idea of eliminating the undesirable features, which at present obtain. The methods of collection adopted will depend on the conditions to be met, and will necessitate considerable study and practical experimenting. This can only be undertaken when the method of disposal has been definitely determined.

Irrespective of the manner of disposal adopted, it will be necessary to continue to dispose of ashes as at present, viz., as filling for low lands. This being the case, the cost of collecting ashes will remain constant, and has, therefore, no bearing on or influence in determining the method most advantageous in the collection and disposal of other classes of waste.

The points to receive attention are as follows:

(1) The removal of waste from the premises in such manner as to eliminate the unsightly appearance of the streets on collection days, where receptacles are placed on the curb and remain there during the day.

(2) Type of equipment used in collection to be such as will prevent the scattering of material on the streets, and the creation of dust when contents are being discharged from receptacle into wagon.

(3) The improvement in type of receptacle; the ideal condition being, of course, a standard container.

(4) The development of collection methods from a sanitary and economical standpoint. (The greatest cost in making collections results from the time required to load, due to equipment remaining idle while material is being picked up.)

When disposal is made by incineration, a combined collection of garbage and rubbish is usually made. This requires the householder to provide a receptacle for the material in a combined state, and relieves the tenant of the trouble of making a separation at the house.

If disposal is made by the reduction method, it will require the householder or tenant to keep garbage entirely separate from rubbish.

It must be borne in mind that in changing from a combined collection of garbage and rubbish, to a separate collection, separate collection wagons for each class of refuse, as well as separate containers for each class, will be required.

Unless there be hearty co-operation on the part of householders, and they are educated to render assistance, it will be difficult to obtain the desired results, since without proper separation, the costs of reduction will be increased, and with a combined collection the reduction of garbage will be positively prohibitive from a practical standpoint. The adoption of this method will mean the strict enforcement of regulations governing garbage collections on the part of this department.

Climatic conditions tend to make separate collections in Toronto difficult, as during the winter months, unless well drained, garbage will freeze in the containers, though with due care in the draining of garbage before it is placed in the container, and the use of paper, this may be eliminated to a very large extent.

When garbage is mixed with rubbish, it is necessary from a sanitary standpoint to make more frequent collections, whereas with separate collections, a more frequent collection of garbage could be made if deemed advisable, and a less frequent collection of rubbish.

When separate collections are made, a wagon having a much larger capacity than our present carts, can be used to advantage for the collection of rubbish, the size being limited to a wagon that can be handled in the places where collections must be made.

It is the intention of the department to experiment with what is known as the "Roller System," whereby cans are brought from the house to the curb by men in advance of the collection wagons, and, after the material has been placed in the wagon, the empty cans are returned to the premises by men who follow up. It is expected that this will permit of the more satisfactory and expeditious loading and removal of the material.

It has been assumed by the department in its estimates of costs that the present practice of requiring the householder to place the receptacles on the curb will be done away with, and that all collections, where possible, will be made from the premises. This will eliminate the unsightly appearance of the streets, due to the fact that receptacles frequently remain from morning until night on the streets on collection days. It will, however, relieve the householder of the trouble of placing the can on the curb and returning same after its contents have been emptied.

Costs of Collection.—In estimating the cost of collection, many items will of necessity have to be considered, such for example as the type of equipment used, and the advantage of the same as to loading and unloading; the size of the wagon used in making collections for each class of material, and the maximum load of each class of material which can be economically placed on each wagon.

The costs will vary under different conditions, with the different types of equipment used. For example, the cart which is now in use will permit a man to load the material at a less cost per ton than the same work could be done by one man using a team and wagon. This is due to the increased cost of the team and wagon over the one horse and cart.

The productive cost of the man and cart as now operated by the department, amounts to approximately $4.33 per day, while the cost of the team and wagon, with driver, amounts to $5.83.

One man will load as much material per hour on to a cart as he will on to a wagon, so that the cost of loading, under similar conditions, increases where the wagon is used, but as the wagon will hold considerably more material than the small cart, if of proper capacity, the cost per ton mile will decrease in proportion to the weight carried. For example, the material can be placed on the cart at a less cost per ton than it could be placed on the wagon (both remaining idle meanwhile), but with increased capacity of the wagon, the quantity hauled by it will decrease the cost per ton mile haul. It is, therefore, obvious that with any great distance to be travelled, the wagon will show a considerable saving, due to its larger capacity.

In this connection, it must be evident to all citizens that the carts at present in use by the department are taxed beyond their capacity, and are thereby rendered unsightly in appearance in collecting from house to house and travelling our public thoroughfares. It must also be evident that before the load can be collected, and the canvas placed on the cart, more or less of the material is scattered on the streets, thus rendering them untidy, particularly in the residential sections, and throwing an extra burden on the street cleaning section of the department.

As already stated, the type of equipment to be recommended for adoption will, to a great extent, depend upon the method of disposal determined, and so soon as convenient after this question has been settled, studies will be made, using various types of equipment for collection by various methods, with a view to installing that which is found to be most suitable from a sanitary and economical standpoint.

Methods of Disposal Considered.—(1) Total incineration of all rubbish and garbage, and such quantity of ashes as required for their fuel value, the bulk of the ashes being disposed of as fill; and (2) Total incineration of rubbish, and reduction of garbage, with ashes disposed of as fill.

The results of the studies made were applied to twelve projects, assuming possible locations of disposal plants or loading stations for the transfer of refuse to a central plant by steam railways, electric trolleys, or motor trucks.

In considering the method of total incineration in high-temperature furnaces, the combustion gases, where possible, should be used in generating power, but due to the price at which electric current is furnished by the Hydro-Electric Commission, it is not feasible to generate electric current from power that can be developed in the refuse furnaces, since to do so would not warrant the additional first cost of installation, or increased cost of operation. It has not been possible to find any outlet for the utilization of steam, inasmuch as at such locations as the quantity produced might be profitably utilized, the demand would not be constant. Again, where the demand would be constant, suitable sites are not available for the installation of furnaces.

Of the 12 projects investigated, 3 of them appearing the most feasible are summarized in the report according to the accompanying table.

The report recommends the adoption of project "C" which provides for the total incineration of rubbish and reduction of garbage in a combined central plant erected at Ashbridge's Bay, the material to be transferred thereto from three loading stations in the western, northwestern and northern sections of the city.

It is proposed, under the method of disposal recommended, to have all material collected delivered to the loading stations, and thence transferred either by steam railway, electric trolleys, or motor trucks, to a central disposal plant located at Ashbridge's Bay, except the rubbish and garbage collected in the territory adjacent to the central plant, which will be delivered by the collection wagons direct. The garbage will all be scientifically treated in a reduction plant, the rubbish incinerated, and the power developed from the rubbish furnaces used in operating the reduction plant, the high temperature produced being utilized to deodorize the gases.

The central plant at Ashbridge's Bay (assuming the adoption of the department's recommendation), will consist of an unloading building, in which all garbage delivered at the plant will be unloaded. All handling of material as delivered will take place in this building. The garbage from the unloading building will be delivered into reduction machinery in the reduction building, where it will be broken down by heat in enclosed equipment, and not exposed until thoroughly sterilized.

The free grease and water will be separated from the solids in the reduction building, the solids being delivered to drying building, and the water and grease to the grease separating building. The grease will be separated by gravity from the water, and the remaining

Summary of Three Proposals.

Project.	Capital cost.	Collection			Disposal			Fixed charge	Revenue			Net Annual Cost		
		1913	1918	1923	1913	1918	1923		1913	1918	1923	1913	1918	1923
A—Total incineration of all garbage, rubbish and part of the ashes, in two, three or four disposal plants.	$480,000	143,061	199,433	280,870	64,145	85,863	114,953	37,056	None	None	None	244,262	322,362	432,879
B—Total incineration of rubbish in two incinerators, and reduction of garbage outside city	$676,000	189,563	265,667	368,707	127,422	159,437	206,140	52,187	159,492	213,468	285,637	209,680	253,823	341,397
C—Total incineration of rubbish and reduction of garbage in central plant located at Ashbridge's Bay.	$720,000	173,681	240,531	341,887	112,164	149,007	193,502	55,584	159,492	213,468	285,637	181,937	231,654	305,346

water concentrated by evaporation, to recover the solids that are held in solution, and which in turn will eventually be dried with the other solids to produce a by-product, known as tankage.

The solids as delivered from the dryers in a dry state, will be delivered to the extraction building, where recovery of remaining grease will be made by a solvent.

By the treatment described, all solids originally in the garbage will be recovered, as tankage and grease, and ready for sale or shipment.

The rubbish will be delivered to incinerator building, where it will be burned. The furnaces for this purpose will be connected with boilers, so as to develop steam to be used in reducing the garbage. In addition to the boilers installed for generating steam from rubbish, boilers will be installed for use of coal to supply such additional steam as may be required to complete the process of reduction.

During the operation, all material, so far as possible, will be sealed during the process of disposal, and the gases and steam trapped, so as to pass them through deodorizing scrubbers, and such gases as are not deodorized in the scrubbers, will be exhausted and passed through the rubbish furnaces, where they will be deodorized by being subjected to a temperature of from 1,200 degrees to 2,000 degrees F. It is also intended to exhaust the air from rooms which might contain odors, and to utilize the air so exhausted to supply a draft on the rubbish furnaces.

A SHORT LINE FROM THE MARITIME PROVINCES TO THE QUEBEC BRIDGE.

Surveys have been completed for the construction of what will be known as the Quebec Extension Railway to run from Washburn, Me., through a distance of 110 miles in the State of Maine and 64 miles into the Province of Quebec. The intention is to ultimately continue the road to the Quebec Bridge, connecting there with the transcontinental roads from the west and furnishing a short line from it to the Maritime Provinces. The line will be operated throughout by electricity.

Another electric line, the Aroostook Valley Railway, runs from Washburn, Me., and will afford connection at Presque Isle, Me., with the Canadian Pacific Railway to St. John, N.B.

Mr. S. B. Wass, assistant chief engineer of the St. John and Quebec Railway, is chief engineer of the new project. From him we learn that the construction of the line will include two large bridges of approximately 600 ft. in length over the St. John and Alligash Rivers, and also an 80-foot bridge at Beaver Brook. The Canadian Eastern Construction Company, who have been awarded the contract, will likely begin operations during the coming summer.

The C.P.R. owns or controls 18,000 miles of railway. Its own system is comprised of 13,280 miles, and the Minneapolis and Duluth roads account for some 4,000 miles of track. It has still about 700 miles of spur lines and extensions to build in the west; while the double-tracking will mean an addition of over 4,000 miles of railway.

The state of Minnesota has attained a position in the first rank as far as road improvement is concerned. In 1914, that state will spend $2,500,000 upon roads and bridges, and will inaugurate a system of road patrols for the maintenance of its roads. Nearly 1,500 patrolmen will be assigned to 5 and 8-mile sections of the state highways, and will be held responsible at all times for the condition of the roads.

GRAPHICAL SOLUTION OF THE THREE-POINT PROBLEM.

A GRAPHICAL method of solving on the plane table the three-point problem in hydrographic surveying was given recently by Mr. A. L. Higgins in "Engineering," of London, Eng. His solution is the extension of the well-known method of "two intersecting circles," and is outlined as follows:

Problem.—Given a, b, and c, the plotted positions of three points A, B, and C, and θ and ϕ, the angles subtended at P by A B and B C respectively; to determine p, the position of P on the map (Fig. 1).

Solution.—From b draw lines b e, b f, making the angles a b e, c b f respectively equal to 90 deg. — θ and 90 deg. — ϕ. At a erect a perpendicular to a b, intersecting b e at e; at c erect a perpendicular to b c, intersecting b f at f. Join e f. Let fall a perpendicular from b on e f; this will meet e f at the required point p.

Proof.—On e b and e f as diameters (centres o and o' respectively) describe circles; these will intersect at p, the common apex of two adjacent angles equal to the observed angles θ and ϕ. For, being angles in the same segment of a circle, the angle a e b is equal to the angle a p b, and the angle c f b is equal to the angle c p b. And the angle a e b is by construction equal to θ; therefore the angle a p b is equal to θ. Similarly, the angle c p b is equal to ϕ.

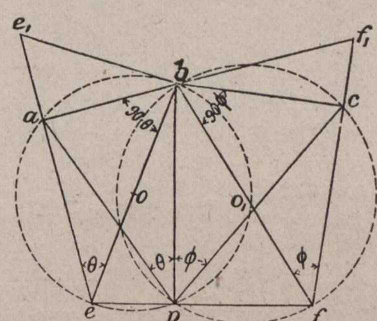

Fig. 1.

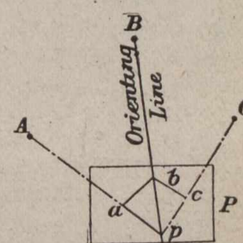

Fig. 2.

The above construction is more expeditious in the office than the one from which it is derived. It is readily effected on the plane table in a manner hereafter described.

The Analogous Plane-Table Problem.—Given a, b and c, the plotted positions of three visible points A, B and C, to determine p, the plotted position of P, the station occupied by a plane table.

(This notation is retained throughout the remainder of this article.)

Here the angles θ and ϕ (Fig. 1) are involved graphically, but the fundamental principle of the plane table precludes the necessity of observing their magnitudes.

The "three-point problem" involves the dual process of—

1. "Orientation"—i.e., setting the board so that the several plotted lines are parallel to, or coincident with, the directions of the corresponding lines in the field.

2. Plotting p, the position of the station occupied. (This is a separate process (resection) in the case of Bessel's graphical solution.)

Although possessing the same characteristic—that of plotting the station occupied—this problem cannot appositely be termed a special case of resection, since the application of that method pre-supposes direct means of orienting the board—a ray drawn in the direction of P at a previous set up over one of the three points A, B, or C.

Thus, for an example of resection, suppose a surveyor has a plane table oriented over B, and a picket at P to indicate a station selected for detail work. Before removing the table he draws a ray through b, the plotted position of B, in coincidence with the line B P, as a direct means for orientation at P. The required point p is somewhere in this ray. He then sets up over P, and orients the board by sighting at B, with the fiducial edge of the alidade along the ray through b. The board oriented and clamped, he determines p at the intersection of the line sighted through a to A with the ray through b to B. As a check he would centre the fiducial edge on c, sight at C, and note if the line thus drawn also passes through p (Fig. 2). But, as far as the three-point problem is concerned, the three points are virtually inaccessible; direct orientation is therefore precluded, and resort must be made to one or other of the mechanical, graphical, or trial solutions.

Some years ago the writer observed that the extended hydrographical solution (Fig. 1) might be readily adapted to the analogous plane-table problem, with special application to cases in which the angles subtended at P by the points A, B, and C, were large, and, in consequence, frequently necessitated additional construction in the application of Bessel's method. Not only

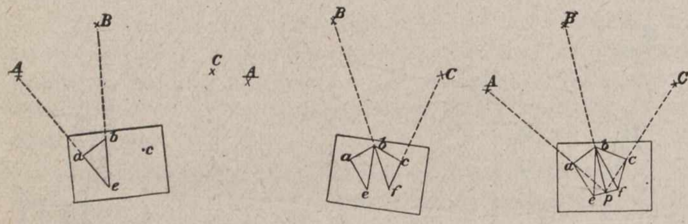

Fig. 3.

was this advantage manifest on trial, but the facility of soon estimating whether a station selected at random was within the limits of plotting, the reason of which is inherent in the fact that the required point lies in the line of two previously determined intersections.

The field routine of this method is as follows—

(The three positions of the board in Fig. 3 correspond to the three principal steps.)

First Step.—(1) Level up the table over P, the station selected, and draw a line perpendicular to a b at a. (This corresponds to erecting the perpendicular a e in Fig. 1.) (2) Place the fiducial edge of the alidade ruler along this perpendicular, and sight through a at A, the corresponding point in the field. Clamp the board in this position and repeat the sight as a check against movement. (3) Fix a pin in the board at b, and, keeping the fiducial edge against this pin, turn the alidade until the point B is seen bisected by the cross-hairs of the telescope, or, in the case of a sighted alidade, coincident with the sighting slits. Draw a line along the fiducial edge to intersect the perpendicular in e. (Thus at e, θ, the angle subtended by A B at P, Fig. 1, is set out graphically, the board being regarded a point in comparison with the area surveyed.) (4) Unclamp the board.

Second Step.—(1) Draw a line perpendicular to b c at c. (This corresponds to erecting the perpendicular c f in Fig. 1.) (2) Place the fiducial edge along this perpendicular, and sight through c at C. Clamp the board in this position, and take a check sight against movement. (3) Turn the fiducial edge about the pin at b until the point B is seen bisected by the cross-hairs of the telescope, and, holding the alidade in this position, draw a line along the fiducial edge to intersect the perpendicular from c in f. (Setting out the angle ϕ graphically at f, Fig. 1.) (4) Unclamp the board.

Third Step.—(1) Place the fiducial edge through the points e and f, and slide a set-square along that edge to p, the foot of the perpendicular from b on e f. (This corresponds to joining e and f, and letting fall the perpendicular from b on that line.) (2) With the fiducial edge through p and b, orient by sighting at B in the direction p b; clamp the board in this position, and check the accuracy of p by sighting through a to A, and through c to C. (Checking by resection.) No "triangle of error" should result—i.e., the rays passing from A, B, and C through a, b, and c respectively should definitely intersect at p.

Notes.—(1) When the station P is situated on the circle through A, B, and C, the problem is indeterminate. This case is evident when the lines b e, b f coincide, but in practice the limit is reached when the angle e b f is very small.

(2) When one or both of the angles subtended at P are greater than 90 deg. (as is the case when P is within the triangle formed by A, B, and C) obtain the intersection e_1 or f_1, or both, as the case may be, by producing backwards one or both of the perpendiculars at a and c (Fig. 1).

(3) When one or both of the intersections e and f cannot be obtained within the limits of the board, the point p may also be indeterminate for the stations selected. The likelihood of this result should be judged (by estimating the position of the line between e and f) before resort is made to the following construction:—

Erect perpendiculars at the middle points of the lines a b and b c—i.e., parallels to a e and c f, to intersect the lines from b to e and f in, say, o and o^1 respectively (Fig. 1). Let fall, as in text, a perpendicular from b on the line joining o and o^1, and, using this as a means of orientation with respect to B, determine by resection the position of p.

Bisection.—Any convenient ratio other than one-half may be chosen, provided that the lines a b, b c are proportionately divided from b.

CANADIAN INLAND WATERWAYS.

Preparation on the part of the Government for the construction of a new canal at Sault Ste. Marie indicates the magnitude of the scheme to improve the navigation of Canada's great waterway of the St. Lawrence and the Great Lakes. It is now evident that besides the new Welland Canal another will be built at the Soo, and the St. Lawrence canals deepened so that all will be equal in facility and size for handling the greatly expanding traffic. The new Welland Canal will have a depth of 31 feet, which can be increased 4 feet without rebuilding the locks, so that this waterway is eventually intended to accommodate vessels of 35-foot draft, or equal to many of the large liners now running between Montreal and Liverpool. The Soo Canal will be constructed of an equal depth, and the improvement of the St. Lawrence canals will give Canada a waterway from the ocean to Fort William that the largest ocean freighters can navigate. Cargoes will not need to be broken as they now are at Port Colborne, Kingston and Montreal. Toronto Harbor must be completed in four years. By this time the new Welland Canal will be ready for traffic, and from the activity of the Government it is certain that along the whole length of this great waterway the improvements on the canal systems and harbors will either be completed or nearing completion.

PARAFFIN BODIES IN COAL TAR CREOSOTE AND THEIR BEARING ON SPECIFICATIONS.*

By S. R. Church and John Morris Weiss.

In specifications for coal tar creosote there is usually a paragraph stating that the oil shall be a pure product of coal tar, and free from adulteration with any oil or products from any other tar. The purpose of this clause is usually to provide against admixture with petroleum products, such as water gas tar or oil tar derivatives. In the present paper the writers wish to consider one requirement which is sometimes introduced with the object of enforcing this provision.

Coal tar is made up mainly of aromatic compounds, and the presence of bodies belonging to the saturated paraffin series has been regarded by some as direct and unmistakable evidence of contamination of coal tar creosote by distillates from other tars.

Dean and Bateman[1] proposed a sulphonation test for creosote oils, based on the principle that aromatic hydrocarbons dissolve in concentrated sulphuric acid to sulphonic acids, while bodies of the paraffin series remain unattacked. They applied this test to numerous creosote oils, and concluded that any oil yielding a sulphonation residue was contaminated with products of other source than coal tar.

A modification of this test, devised by J. M. Weiss, was proposed in an article by S. R. Church,[2] which did not in any way change the results of the test, but merely made it easier of operation, so far as the detection of traces was concerned. Later, Bateman[3] made further modifications in the test, which made it a still more convenient laboratory operation. This modification was endorsed by Church[4] after trial as more convenient and practical than the earlier proposals.

Chapin[5] proposed the substitution of a dimethyl sulphate test to be used to determine paraffin hydrocarbons in creosote oil, as well as in creosote oil dips. Reeve and Lewis[6] have used this test, and have given a number of results obtained by it.

A brief description of the tests in question may be useful in this connection:—

Sulphonation Test.—"Ten cubic centimeters of the fraction of creosote to be tested are measured into a Babcock milk bottle. To this is added 40 cubic centimeters of 37 times normal sulphuric acid, 10 cubic centimeters at a time. The bottle with its contents is shaken for two minutes after each addition of 10 cubic centimeters of acid. After all the acid has been added, the bottle is kept at a constant temperature of from 98° to 100° Centigrade for 1 hour, during which time it is shaken vigorously every ten minutes. At the end of an hour the bottle is removed, cooled and filled to the top of the graduation with ordinary sulphuric acid, and then whirled for 5 minutes in a Babcock separator. The unsulphonated residue is then read off from the graduations."

Dimethyl Sulphate Test.—"Five cubic centimeters of the fraction is pipetted into a narrow 25 cubic centimeter burette, and shaken with 8 cubic centimeters of dimethyl sulphate after closing the burette with a smooth, close-fitting cork. Separation of the residual oil occurs in a short time in the form of a clear, almost colorless, supernatant liquid layer."

* Presented before Section D of the American Association for the Advancement of Science at the Atlanta Meeting, December, 1913.

We will first briefly discuss the relative merits and demerits of the sulphonation test and the dimethyl sulphate test, and then consider in what manner the results of such a test should be interpreted, particularly as regards creosote oil specifications.

We have made some experiments, using the dimethyl sulphate test, as recommended by Chapin, and the modified sulphonation test with fuming sulphuric acid and the Babcock bottle, as proposed by Bateman. Average samples of coal tar oil and water gas tar oil were distilled, and fractions taken from 240° to 270° Centigrade, and from 270° to 300° Centigrade. These fractions were then subjected to the dimethyl sulphate test and the sulphonation test, with the following results:—

	Sulphonation Test Residue.	Dimethyl Sulphate Test Residue.
Coal tar distillate, 240-270° C....	1.2%	0
Coal tar distillate, 270-300° C....	2.0	0
Water gas tar distillate, 240-270° C.	4.0	0
Water gas tar distillate, 270-300° C.	6.8	0

Further tests on other oils were also made, with the following results:—

	Sulphonation Test Residue.	Dimethyl Sulphate Test Residue.
Water gas tar distillate, 240-270° C.	2.4%	0.0%
Water gas tar distillate, 270-330° C.	1.2	0.0
Mixed tar distillate, 240-270° C...	2.0	0.0
Mixed tar distillate, 270-330° C...	3.0	0.0
Blast furnace tar distillate, 240-270° C.	17.6	23.0
Blast furnace tar distillate, 270-330° C.	23.2	38.0
Oil tar distillate, 240-270° C.....	14.4	22.0
Oil tar distillate, 270-330° C.....	18.8	28.0

It can be seen from these results that the dimethyl sulphate method showed no residue in many oils that gave measurable residues by the sulphonation method, and we feel that the former test is of no value, so far as the detection of small amounts of saturated hydrocarbons in the presence of aromatic hydrocarbons is concerned. Undoubtedly, if there were considerable amounts of petroleum or blast furnace tar distillate present, where there might be a sulphonation residue of from 10 to 20 per cent., the dimethyl sulphate test would detect it, but where there is only a question of comparatively small admixtures of material, itself low in sulphonation residue, this test would not seem to be of any value.

We have experienced great difficulty in obtaining dimethyl sulphate; moreover, we find that it rapidly changes on standing, so that fresh supplies must frequently be had. Another objection to this reagent is the danger attendant upon handling it.

In a great deal of our laboratory work on oils distilled from various kinds of tar, the results have been clouded by uncertainty as to the authenticity of the sample. Some time ago, therefore, we procured samples of tars from typical coke ovens and gas plants under such conditions as to make accidental contamination or admixture practically impossible. These tars were distilled to pitch, and the distillate oils recovered. The oils were subjected to a number of tests, partially along the lines of Dean and Bateman's work (loc cit). It is not our intention to give the details of this work at present, except in so far as they affect the question of the sulphonation test.

Coal tars may be divided into two classes:—

1. Coke oven tars, which may be further subdivided according to the type of oven in which the coal is carbonized.

2. Gas works tars, which may be divided similarly into horizontal, inclined and vertical gas works tars.

In this investigation we had one or more samples from each of the different types of installation, both coke oven and gas works, and have, we believe, examined a sufficient number of samples to draw correct conclusions.

The examination of the oils, which is of interest in this connection, was a Hempel distillation (made in accordance with the Forest Service method for analysis of creosote oil), taking fractions at the following points on the Centigrade thermometer: 210°; 210-225°; 225-235°; 235-245°; 245-255°; 255-265° 256-275°; 275-285°; 285-295°; 295-305°; 305-320°; 320-330°. These fractions were then subjected to the sulphonation test, using Bateman's modified, as described above. In the appended table are given the results of these tests of the various oils examined, representative tests of each type of installation being selected. Where there were any great variations between oils of the same origin, the tests of the two most widely divergent materials examined are given:—

Sulphonation Residues of Oils from Authentic Samples of Tar.

Oils derived from	210°	210-225°	225-235°	235-245°	245-255°	255-265°	265-275°	275-285°	285-295°	295-305°	305-320°	320-330°
Semet-Solvay coke oven tar	0	0	0	0	0	0	0	0	0	0	0	0
Koppers coke oven tar	0	0	0	0	0	0	0	0	0	0	0	0
United Otto coke oven tar	0	0	0	0	0	0	0	0	0	0	0	0
Horizontal gas retort tar	0.2	0.2	0.4	0.6	0.8	0.8	0.8	0.8	0.8	0.4	0.4	0.4
Inclined gas retort tar	2.0	2.0	2.0	4.0	5.6	6.4	5.2	6.4	6.0	5.6	5.2	4.0
Vertical gas retort tar	5.8	3.6	3.6	4.6	5.6	5.6	6.2	4.8	6.0	4.0	4.4	2.2
Water gas tar, 1	0.4	0.4	0.4	0.4	0.4	0.8	0.8	0.8	0.8	0.8	0.4	0.4
Water gas tar, 2	3.2	5.2	6.0	6.4	7.2	9.2	10.4	10.0	14.2	13.6	13.6	12.4
Oil tar	9.2	22.8	26.4	26.4	26.0	33.2	31.6	35.6	42.4	36.0	32.0	32.0
Blast furnace tar	...	11.6	14.4	16.4	17.2	20.4	21.2	22.0	20.8	20.4	18.0	16.4
Lignite tar	7.0	7.0	9.8	11.6	13.4	14.8	17.0	20.4	20.4	19.6	19.0	12.0

A consideration of the creosote oil specifications in active use indicates a tendency toward the use of the sulphonation test. The requirements of the test vary widely; in one case, the sulphonation residue is limited to 10 per cent. in others, to 1 per cent., while still others specify that in the fraction 300° to 360° C. it shall not exceed 0.25 c.c.

In a Forest Service Circular C. P. Winslow[7] gives the requirement for Class 1 and Class 2 coal tar creosotes, which are the only ones considered by him as pure coal tar creosotes, that there shall be no sulphonation residue. In "mixed coal tar creosotes," he allows, in Class 1, 10 per cent. of the 305-320° C. fraction as a sulphonation residue, and in Class 2, 20 per cent. of the fraction 305-320° C., expressing it in the form that "the volume of the sulphonation residue in cubic centimeters should not be greater than one-tenth or one-fifth, respectively, of the weight of the fraction in grams."

In the opinion of the writers, the requirement of no sulphonation residue is unfair as a basis of classification of pure coal tar creosote; and a very high limit for mixed creosotes, such as 10 to 20 per cent., is useless, as it makes it unnecessary, *per se*, to have any coal tar creosote at all present, in view of the fact that a great majority of the water gas tar distillates have considerably less than this amount of sulphonation residue in any fraction. If a requirement for no sulphonation residue should be enforced, only straight coke oven tars could be used to produce such creosote oils, and this is certainly a commercial impossibility for the most part. If a limit of 1 per cent. is set, the coke oven tar oils and some of the horizontal gas works tar oils would meet the requirement, but some of the latter would require the admixture of coke oven tar oils to bring the percentage below this limit. Also, if a tar distiller should be handling considerable quantities of inclined or vertical gas works tars, oils containing as low as 15 to 20 per cent. derived from these tars might fall outside of the 1 per cent. sulphonation residue limit.

The writers feel that a fairer limit for such specifications would be about 2 per cent., as this would not bar any normal coal tar creosote oils, and would at the same time prevent the admixture of petroleum products (other than those from water gas tar), blast furnace oils, etc. The admixture of water gas distillates will, of necessity, have to be taken care of in some other way than by the sulphonation test, as it is very plain that certain mixtures of coke oven tar oil and water gas tar oil of a low sulphonation residue, would show a lesser sulphonation residue than most oils obtained wholly from gas works coal tars.

We believe, moreover, that we have demonstrated the sulphonation test of itself to be of comparatively little value in detecting the admixture of oils of petroleum origin, particularly those derived from water gas tar, with creosote oil.

In a later paper we intend to publish additional data from our analyses of authentic tars, indicating the value of certain other tests, as means of determining the origin of oils used for creosoting.

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PIPE CONDUITS MADE OF CONCRETE.

An economical method of constructing efficient and durable conduits of concrete for small steam lines is described in a recent issue of "Power," from which the following illustrations and remarks are reproduced:—

The trouble experienced in installing and maintaining steam lines underground is well known, especially where cinders have been used for grading. To lay a pipe line in cinders means a continuous digging up and renewing of pipes, for the life of wrought-iron or steel pipe in cinders is short and cinders alone make a poor insulator.

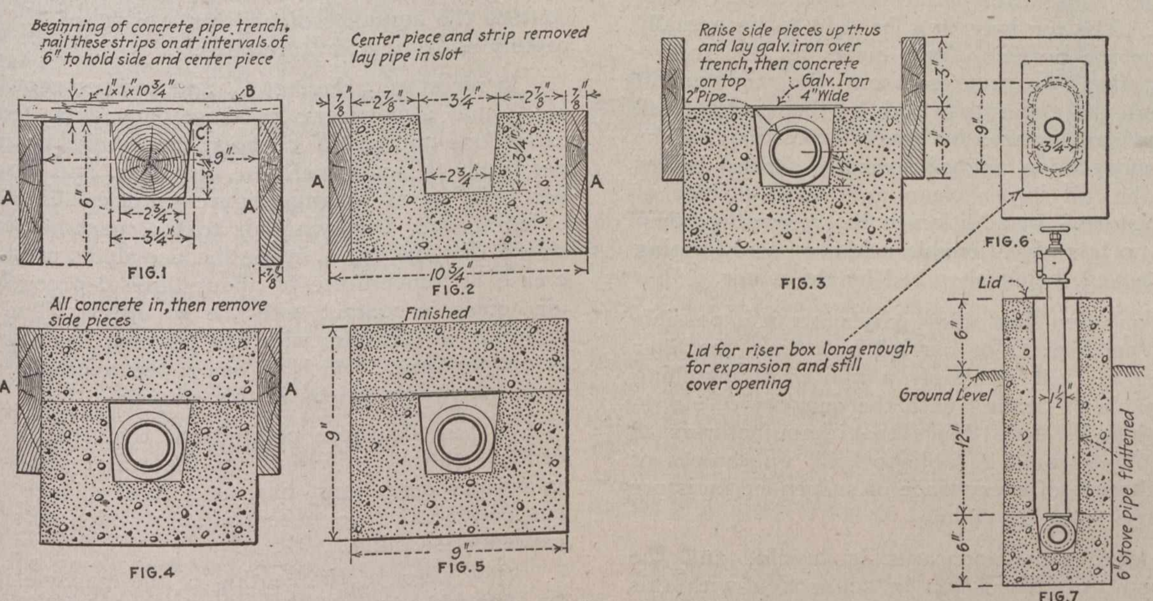
Some kind of covering must be employed to save the pipe and to prevent condensation. After using several kinds of material, including tin-lined wood casing, ordinary tile, split tile, and oak, pine, cypress and other kinds of wood coverings, each has been found to have its faults. Concrete conduits have been used for air and oil lines, there being little expansion or contraction, but providing for a steam line is a different proposition. With the knowledge gained in laying approximately 17,000 ft. of air lines in concrete, and knowing that it was immune from disintegrating action of the elements and of the cinders, a similar conduit for steam pipes was employed. It is very simple and less expensive than others, and to those who would keep down the cost of maintenance and raise the standard of service, our manner of providing conduits for small sizes of underground steam pipes may be of interest.

A method of providing for a 2-in. steam line would be to first dig a trench the required size and depth, and set in it two 7/8 x 6-in. fence boards *A*, Fig. 1, placed on edge, 9 in. apart. Next, nail a piece *C*, used as a core for forming the slot in the centre, to the strips *B*, 1 x 1 x 10¾ in. spaced 6 ft. apart, and tack them to the side boards. The ditch is then filled with concrete in sections, each about 12 ft. long, made of 10 parts of small stone or gravel, five parts sand and two parts cement. Mix the concrete to a slush and fill the form level with the top. Do not trowel the top, but use a broom to roughen the top surface, as the top will adhere better than if slicked with a trowel.

When the concrete is set, and it will generally harden enough in 12 hr., remove the strips *B* and lift out the centre core, leaving the concrete as shown in Fig. 2.

Now lay the pipe, as shown in Fig. 3, and cover the slot with a strip of thin galvanized or stove-pipe iron about 4 in. wide. Raise the side boards up 3 in., tamp dirt around the outside to hold the boards in place and fill with concrete to the top of the side boards, as in Fig. 4. When the concrete has set dry, remove the side boards, leaving the finished conduit of section like Fig. 5. If the ground is likely to hold water after a rain, it is well as an extra precaution to coat the sides and top of the conduit with hot coal tar, or with a heavy paint.

Care should be used where the risers come above the ground. For such places use a piece of 7-in. stove-pipe of the right length, split and flanged over at the lower end, and flatten the sides so as to leave space for the steam line to expand. After placing the stove pipe over the riser, set a box 9 x 15 in. around the stove pipe, both extended about 6 in. above the ground line, and fill with concrete, as in plan, Fig. 6, and vertical section, Fig. 7. When the concrete has set, remove the outside form, pack the dirt firmly around the riser box and provide a sliding lid of sheet iron, as shown, to exclude dirt and hinder the circulation of air.



Figs. 1, 2, 3, 4 and 5.—Cross-Sections of Conduit. Fig. 6.—Lid for Riser Box. Fig. 7.—Vertical Section of a Riser Box. Concrete Conduit for 2-in. Steam Line.

If a leak appears, remove a section of the top with a wedge, draw out the pipe, repair the leak and replace the top with new concrete. A length of 25 ft. of pipe can be drawn out and replaced with no trouble. This cannot be done with wood, log, tile, wooden box, or most other kinds of conduit on account of the inside supports. Many hundred feet of this kind of conduit have been installed and no trace of cracks has been found at any of the places that were uncovered to examine the concrete.

Giving evidence before the Dominion's Commission on March 14, Mr. Nicholson, harbor engineer, stated that in the course of the next two years Cape Town harbor would be able to accommodate vessels 750 feet long and drawing 38 feet of water; and also that further development work had been approved by the government.

In 1913, according to returns received, 8,996 men found employment in the mines, quarries, clay-pits and ore-mills in the Province of Quebec. The total wages paid amounted to $5,179,395. A certain proportion of these men were employed for part of the year only, but the majority worked 300 days. There were 15 fatal accidents; of these, ten occurred in the asbestos mines; four in quarries, and one in a copper mine.

THE WET FILTRATION OF COOLING AIR FOR ELECTRICAL MACHINERY.

THE application of air, cleaned by what is now generally known as wet filtration, to the cooling of electrical machinery is a comparatively recent innovation, and the installations of this type are as yet few in number. Owing to the rapidly increasing number of turbine-driven generators requiring large and constant volumes of ventilating air, engineers are much interested in the method, and are discussing its possibilities. While on the one hand some are favorably disposed towards the new practice, the majority, frankly doubtful, prefer to await the verdict of time in those cases where it is in use before coming to a final decision. As the time is opportune, we reproduce the following remarks on the subject contained in an article by Mr. D. A. Hackett in the Electrical Review, dealing with a few of the technical aspects, with the view of stimulating the discussion of the practice.

The process of wet filtration may be briefly described as the bringing of the air which is to be cleaned into intimate contact with water in the form of a very finely divided spray. The air may thus be said to be actually washed, for as the particles form nuclei for the formation of drops, they are removed from the air current passing through the apparatus, both by their rate of fall being rendered greater and by the interposition, in the path of the spray-laden air, of specially shaped baffles from which the air issues clean and without trace of suspended moisture. In addition to the removal of dust particles, the no less objectionable acids, or acid-forming gases, are removed, being absorbed by the water.

The first question that arises is whether it is possible for the water particles to be carried over from the filter by the moving air. It is simply a matter of installing apparatus capable of dealing with the quantity of air required, and there is little doubt that manufacturers of this class of plant would be able to fulfil guarantees of the absolute absence of every trace of suspended moisture in the discharge from the filter.

The air leaving the apparatus is humid, and the greatest amount of discussion in connection with this subject has been devoted to the possibilities attaching to this condition. The insulation resistance of material is reduced by the presence of moisture in it, and considering only the humidity of the filtered air, it might be unsafe, to say the least, to pass it in its practically saturated condition through a machine. This view may be considered from several aspects. It must be remembered that the climate of this country is such, that electrical machines are frequently subjected (more often of course in winter) to atmospheric conditions approximating to 100 per cent. humidity for long periods. This is the case particularly where the machines are of the type requiring forced ventilation, and it is ordinary practice, where the environment is suitable, that is, where the atmosphere remains clean, to pass the air through machines unfiltered, without damage resulting to the insulation. In foggy weather the air is supersaturated and contains particles of moisture, but there is no record of machines having broken down due to the reduction of the insulation resistance at such times, nor is any provision ever made to reduce the quantity of moisture in the event of a fog or unusually humid atmospheric conditions. Finally, machines are insulated for use under ordinary conditions of surrounding air; in practice manufacturers' tests are specified to be made without any special precautions with regard to humidity, and in very many cases it is even specified that the apparatus under consideration should remain in the shops for some days previous to testing subjected to ordinary atmospheric conditions. It would appear then, that the factor of safety of insulation as applied to electrical machines in general would cover such of these as are ventilated by wet-filtered air.

It might be of interest to examine the effect of the passage of the air to and through the machine, on the air itself. Let it be assumed that the filtered air is saturated, that is, that its humidity is 100 per cent. (actually it does not always reach this, the average condition being more nearly represented by 95 per cent.). The air leaving the filter passes to the machine but before coming into contact with the windings, it has to encounter resistance in the form of ducts and bends, and has also to be forced through the machine by some form of fan. In this process energy is expended, the air temperature is raised, and the humidity thereby reduced. It may seem that this effect is slight, but in the first place it requires a comparatively small amount of energy to raise the temperature of a cubic foot of air through one degree (0.575 watts per cubic foot per minute), and for a given moisture content the humidity of a given weight of air decreases rapidly as its temperature rises.

If air at 19.5 degrees C. and 100 per cent. humidity at normal atmospheric pressure, have its temperature raised one and a half degrees, the humidity drops to 90 per cent. If an actual case be taken, and assuming 65 per cent. as an average figure for the efficiency of the external fan supplying air to the machine, calculation shows that the losses in the fan and ducts produce an increase in temperature of about three degrees before the air comes in contact with the windings. The resulting humidity in this case with 100 per cent. leaving the filter is 79 per cent., which is below the average for winter atmospheric conditions in this climate.

It has also been pointed out that the air around a central station, by reason of the water vapor liberated in various operations, has, as a rule, a large amount of suspended moisture present against which no special precautions are taken.

The effect of the heating of the machine itself must be considered. An examination of the heating curve shows a sharp and immediate rise in temperature after putting on load. This should act in the direction of preventing an undue absorption of moisture by the windings, should the humidity be high. It is also worthy of consideration to note that in a generating station, due to the radiation from steam pipes, engines and generators, the air temperature is higher than the external air, and, as a result, the windings of a machine, when put on load, are already several degrees higher than the cooling air, and therefore initially more likely to resist the condensation of moisture in them. This fact, taken in conjunction with the rapid rise in temperature referred to previously, and the increase in temperature due to work done in moving the air, tends towards the reduction of the percentage of humidity, and therefore to the original condition of the air as regards moisture previous to filtration.

It is claimed that the air is cooled as well as cleaned by the process of wet filtration, and as this tends in the direction of a lower maximum temperature, it is desirable to form some idea as to the amount of the reduction in air temperature and the effect of the increased moisture content on the cooling qualities of the air, that is, practically speaking, on its specific heat. If air be taken at atmospheric conditions of temperature, pressure and humidity, and caused to take up water vapor in such an apparatus as the filter under discussion, the air will be cooled owing to the heat absorbed in the evaporation of the water. It is correct to assume that the quantity of heat lost by the air is equal to that absorbed by the water during evaporation. From this consideration the reduction in temperature due to air taking up various quantities of moisture can be calculated, and from hygrometric charts it is a simple matter to obtain the amount of vapor present at the assumed condition (for air leaving the filter) of 100 per cent. humidity at any temperature. The temperature to which air at any other temperature and humidity falls when saturated in this manner, can be obtained with reasonable accuracy. The air temperature will not be reduced quite to the wet-bulb temperature corresponding to the atmospheric conditions, but to a temperature slightly higher, due to the increase of the moisture content consequent on the passage through the filter. A concrete example will make evident the extent of the cooling effect.

If air at 13.9 degrees C. and 81 per cent. humidity, corresponding to average summer conditions, be treated in a wet filter so that it emerges at 100 per cent. humidity, the resulting air temperature is 12 degrees C. The wet-bulb temperature corresponding to the original conditions is 11.75 degrees C. The cooling effect is due mainly to the latent heat absorbed by the water in evaporating, and it does not seem feasible except possibly in special cases still further to reduce the temperature materially by the addition of refrigerating plant, cooling the water supplying the sprays in the filter. It is doubtful if much advantage can be gained in this way unless some highly efficient, compact refrigerator capable of operating without supervision, can be found.

With regard to alteration in cooling qualities, an investigation of the change in specific heat and density, for the average conditions given, shows a 0.2 per cent. increase in specific heat, and an increase in density of, approximately, the same amount, so that there is a slight advantage in these respects also.

Summing up, it would seem that there is a fairly good case for the installation of wet air-filtration apparatus from the purely technical aspect. It undoubtedly produces clean air, the advantages of which it is not necessary to dwell upon, and whilst the reduction in temperature may not, generally, be great, the air is certainly cooler after filtration. With regard to the danger of breakdown, it would be of interest if some experiments were carried out under actual conditions to discover if any material alteration in insulation resistance does occur, and in this connection experience might be gained at first on low-voltage machines, where the risk of breakdown is less. It is outside the scope of this article to discuss the costs of such installations, the different types, or comparative figures for upkeep, but it might be urged that the publication of such particulars would be of the greatest interest to electrical engineers in general at the present time.

The business of the Tungstolier Company of Canada has been taken over by the Canadian General Electric Co., Limited.

It has been stated at Philadelphia that part of the pig iron which R. D. Wood and Company will cast into pipe in their 40,000-ton Italian aqueduct contract, will be brought there from Canada. This particular iron will come from Sydney, Nova Scotia. About 15,000 tons is understood to have been contracted for to be delivered at docks at Philadelphia at about $13.50 per ton.

CONSTRUCTION OF A JETTY OF SPECIAL DESIGN.

By V. J. Elmont, B.Sc., A.M.Can.Soc.C.E.

On the west coast of the Danish peninsula, Jutland, there has been completed a jetty, built of concrete blocks. It is worthy of record on account of the magnitude of the blocks, which are up to 102 tons in weight, its special design, and the difficulties which had to be met during construction owing to the heavy seas on that coast.

The jetty runs 1,000 ft. into the sea and has a width at the top of 20½ ft.; the maximum depth of water is 20 ft. The masonry of the jetty does not begin directly at the shore, but is connected with it by a bridge. The prevailing current conditions made it necessary to provide a free space between the jetty and the shore in order to prevent deposition along the jetty of sand and gravel carried by the coastwise current.

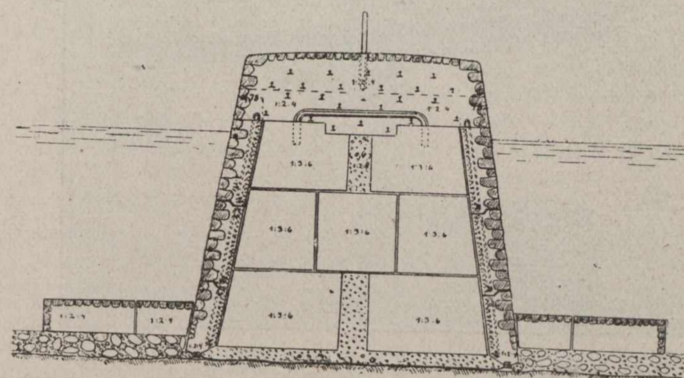


Fig. 1.—Cross-section of Jetty.

The cross-section in Fig. 1 shows the method followed in the design. The outside walls are composed of three 16-ft. long granite-faced concrete shells on top of each other, the operation of placing them being effected by means of a Titan crane of 110-ton capacity. The bottom shell (one of them is seen under transportation in Fig. 2) was placed on the uneven ground, when the loose material covering it had been removed with a grab bucket, attached to the crane (Fig. 3). The bottom shell being in position, a sheet of cloth, connected to the sides of the shell, as indicated in Fig. 2, was spread over the base (shown also in the cross-section). On this was placed a layer of gravel, grouted with cement after being levelled

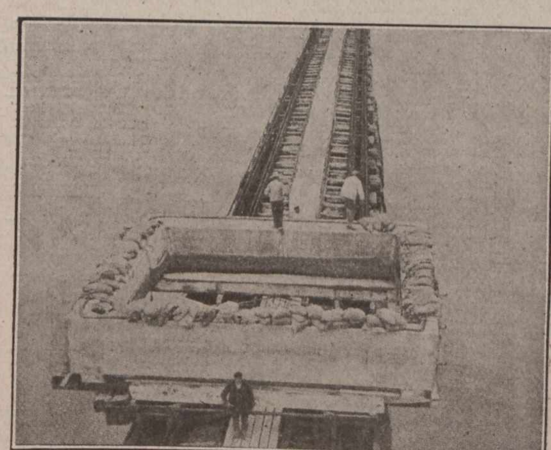


Fig. 2.—Showing a Section on Way to Site.

off. In Fig. 2 will also be noted a thick strand of oakum used to ensure tightness between each pair of shells, and the concrete and cement bags on which the shell was set, thus making a close joint between the base and the shell. The box formed by each set of three shells is filled with concrete blocks and the space left between these with a rich mixture of concrete.

It was originally intended to build the superstructure (granite and concrete masonry) *in situ*, but it was afterwards deemed preferable to adopt block work for a part of it. The superstructure for each section, formed by

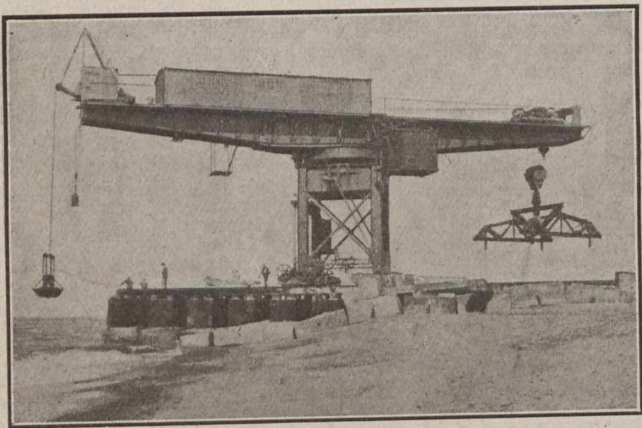


Fig. 3.—110-ton Crane Used in Placing Sections and Blocks.

three shells, was completed by two concrete and granite facing blocks of an average width of 5 ft.; the space between them was filled with 1:2:4 concrete, reinforced with rails running lengthwise in the jetty.

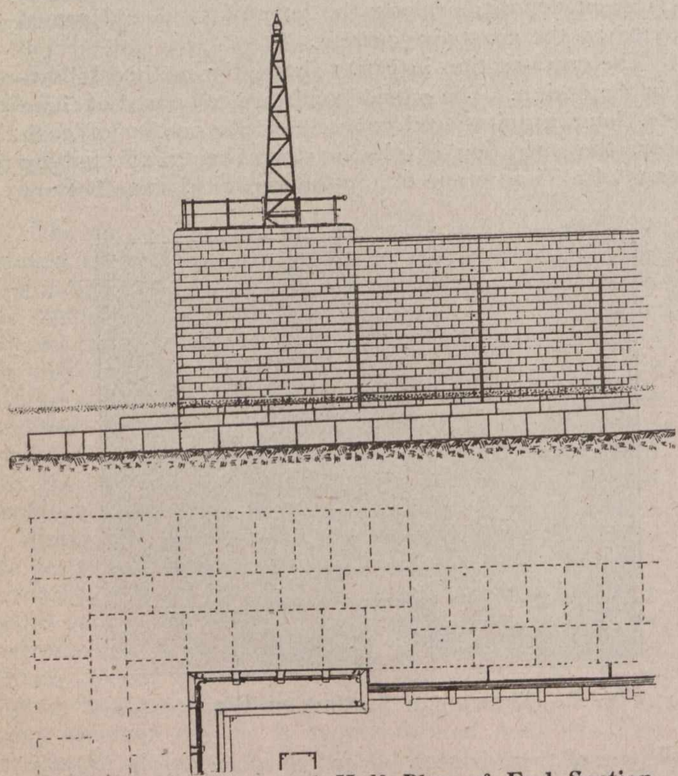


Fig. 4.—Elevation and Half Plan of End Section.

These blocks have the same dimension in the length of the jetty as the shells on which they rest. A continuous expansion joint is thereby formed from the base to the top of the jetty, provision being made for a joint in the concrete forming the centre part of the superstructure.

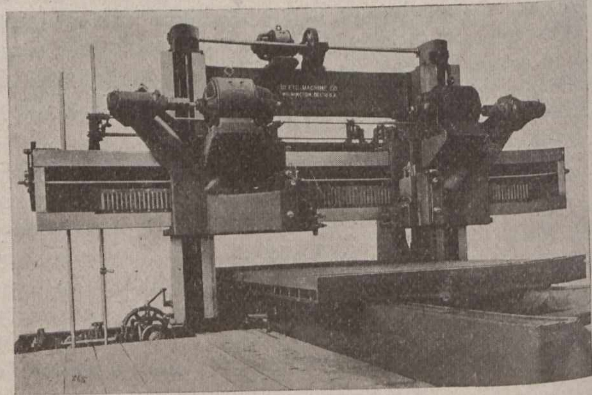
The footing of the jetty is secured against scour by means of two granite-faced concrete blocks on each side, having a total width of 13 ft. At the head of the jetty these blocks are 21 ft. wide, made up of three rows, that nearest to the jetty weighing from 15 to 20 tons, the others 8 and 9 tons respectively.

The head of the jetty (shown in plan and elevation in Fig. 4) was built up of four shells, differing somewhat from those already mentioned. They have vertical sides and are 24 ft. long and 28 ft. wide. Their weight varies from 84 to 102 tons. The total weight of the head section, when filled with concrete blocks, is 1,020 tons, while the one adjacent weighs 638 tons. By the aid of the superstructure these two sections are combined to form one mass, having a weight of 2,035 tons.

SPECIAL PLANER OF INTERESTING DESIGN.

THE unusual type of planer shown in the illustration was built by the Betts Machine Company, Wilmington, Del., for the Commonwealth Steel Company, Granite City, Ill., after the latter company's special design. It is designed especially to machine the ends of castings running up to 30 feet in length, a proceeding that is impossible with the ordinary type of planer. The cutting tools are therefore arranged so as to move at right angles to the platen, which permits machining the ends of castings of any length as well as other surfaces which cannot be reached with the ordinary planer.

The machine consists essentially of a 10 x 7 x 18 ft. planer of standard construction. The cross rail is, however, special and carries two cutting heads, each of which



Planer for Machining Large Castings.

is driven by a 30-h.p. Westinghouse electric reversing planer-motor.

The two motors are connected together electrically so that if one reaches the end of a stroke before the other, it automatically stops and waits for the other to finish its stroke, when they both reverse together. To obviate the danger of the heads running together, a push-rod is mounted on one which opens the circuit and stops the motors if pressed.

The heads are designed for a cutting speed of 30 ft. per minute and a return speed of 75 ft. per minute, and are guaranteed to take two ½ x ⅛-inch cuts simultaneously in cast steel.

The platen is provided with a power rapid traverse of 20 ft. per minute as well as a power feed. It is driven by a 7½-h.p. motor, while the cross rail is raised and lowered by a similar motor.

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CONTENTS OF THIS ISSUE.

LOCAL GOVERNMENT BOARD IN SASKATCHEWAN.

The Third Legislature of Saskatchewan, recently concluded, passed an act to provide for the creation of a Local Government Board, to consist of three members and to exercise broad control over the financial affairs of the municipalities of the province.

Associated with the commissioners for advisory purposes will be two members, appointed annually, one by the organization representing urban municipalities, and the other representing the organization of rural municipalities. The commissioners are not allowed to hold any interest in the securities of Saskatchewan local authorities, or to be members of any company dealing in their securities, nor may they be interested in any work done or contracts let by these authorities. They are also disfranchised both as to municipal and provincial elections.

The term "local authorities" is defined under the Act to mean the council of a city, town, village or rural municipality, the board of trustees of a school district, and the directors of rural telephone companies.

The duties of the board may be briefly summarized as follows: It will have power to inquire into the merits of an application from any of these authorities for permission to raise money by way of debentures or upon security of stock; it may grant or refuse such permission; it may manage sinking funds entrusted to its care; it may supervise the expenditure of money by local authorities; it may demand a detailed statement of the financial standing of local authorities.

All local authorities, excepting cities and towns, desiring to raise money by way of loan, must first make application to the board. Cities and towns must do so prior to the first reading of the money by-law. None of the terms of the existing law as affecting villages and rural municipalities are altered in any way, except that the powers formerly vested in the Minister of Municipal Affairs will in future be vested in the Local Government Board. The same conditions will apply to school districts and rural telephone companies.

The board is given power to investigate the advisability or otherwise of authorizing a loan, and when money is to be borrowed for waterworks or sewerage systems the approval of the Commissioner of Public Health must first be procured, as is provided in the Public Health Act.

The board will have the right to enter upon and inspect any works, require the attendance of any persons whom it sees fit to summon and the production of all desired documents or plans, and in forcing the attendance of witnesses will have the same powers as the Supreme Court.

NO TIME TO TENDER.

Hardly a week elapses but that there is announced some important call for tenders which allows bidders only a week or two for the preparation of their tenders.

"No time to tender" has become a very familiar phrase among Canadian engineering, contracting and manufacturing concerns. Important firms are frequently barred from tendering, simply because of the time element. There are rare occasions when a town or city really requires material or machinery in a hurry. But nine times out of ten, the time allowed bidders could probably be increased by a fortnight, or even a month, without any detriment to the municipality—especially if a little foresight were used and tenders called for promptly as soon as decision to have the work done had been reached.

Too frequently a council decides one meeting to call for tenders and instructs the city clerk to have tenders in hand by the next council meeting. We have in mind one Canadian municipality that allowed only a couple of weeks for tenders for an engine, and then calmly waited for eighteen months for its delivery; and another municipality that allowed less than two months for the preparation of plans and bids on a job amounting to over a million dollars, and then took over ten weeks to decide which of two bidders should be awarded the contract.

This is a matter of equal importance to buyers and sellers, as bidders often submit figures high enough to protect themselves against all risks, when they are not allowed sufficient time to investigate carefully and to figure accurately and closely.

REPORT ON CITY ARCHITECT'S DEPARTMENT, TORONTO.

Last week Judge Denton's report on the City Architect's Department was made public. It is the result of a lengthy investigation, and careful probing into the affairs of the department has brought out strong vindication of the popular belief that much inefficiency and lack of discipline pervaded the system under which it operated.

During the three months of the inquiry 179 witnesses were examined, 2,614 typewritten pages of evidence taken and 170 exhibits filed and considered.

The report recommends a complete reorganization of the department into a separate branch of civic government to be known as the "Department of Buildings." Its jurisdiction and powers are fully enumerated and show considerable increase over the present system. The head of the department, according to the recommendation in the report, should be called the Superintendent of Buildings.

"He should be the best man available. He should not only have the necessary practical and technical knowledge of the work of the department, but should possess the necessary administrative ability to reorganize and systematize the department and to introduce such reforms as will put an end for all time to come of the conditions at present existing."

The official disclosure of many inconsistencies renders it almost inconceivable that the present condition of affairs will be permitted to continue. Obviously, the department is one of the most important in the administration of civic affairs. There is every need for a superintendent possessing (1) technical ability that may be relied upon for accuracy and dispatch in engineering and architural details; (2) executive ability to reorganize and resystemize the department in order to make it efficient, reliable and up-to-date; (3) practical knowledge of the factors representative of the owner, the engineer, the architect, the contractor, the city and the building by-law; (4) disciplinary powers such that the practices which the present department has tolerated will immediately, without modification, cease.

Further, the responsibilities of this office are such as to require a man who will rigidly adhere to the belief that his is a department that cannot permit an invasion of foreign forces in the carrying out of its duties for the protection of life and property.

LETTERS TO THE EDITOR.

Artesian Water in Manitoba.

Sir,—For many years, in fact almost ever since Winnipeg has been a city, it has depended for its water supply on wells sunk through the impervious layer of boulder clay which underlies the city into a bed of porous limestone, from which water rises in great abundance. From these wells the city has been able to obtain a plentiful supply of water which, while containing a slight amount of mineral matter, is absolutely free from any hurtful bacteria, or from organic germs of any kind.

Probably no city on the continent has such a secure supply of sterile water as Winnipeg, but the city council has evidently decided that the supply is not sufficient and cannot be sufficiently increased to keep pace with the rapid growth of the population, and therefore it is said to be making arrangements to bring water from Lake of the Woods in an open aqueduct, and to take all the chances of the introduction of impurities which such a method of obtaining water necessarily entails.

Before stepping down from a safe and sterile water supply to one which may not always be safe and pure, it would be worth while to make every possible endeavor to increase the flow of pure water from the present wells.

The porous limestone into which these wells are sunk, and from which the water rises, extends to the north and west beneath a layer of boulder clay, and rises to the surface in a number of places in the country between lakes Winnipeg and Manitoba at elevations varying from about fifty to one hundred and fifty feet above the level of the prairie at Winnipeg. The rain falls on these bare rocky areas, as well as on the adjoining clay-covered country, but instead of flowing away in rills and streams, as it does on the clay-covered country, it at once sinks into the porous limestone and flows through this limestone southward and eastward until it finally reaches the surface either in the large springs north of Winnipeg or through the wells at the city of Winnipeg itself. The quantity that flows from these springs and wells is therefore largely limited to the amount of the rain-fall on those portions of the surface where the porous limestone is uncovered. Where it is covered, as it is in many places, most of the water derived from the rain either stands in small lakes and evaporates from the surface, or drains off towards Lake Winnipeg or Lake Manitoba by the many little streams which unwater the country.

The underlying porous limestone through which the water percolates on its way from the exposed areas northwest of Winnipeg to the wells in Winnipeg is a magnificent natural filter which is protected from contaminating influences throughout the populated parts of Manitoba by a thick covering of impervious boulder clay. No other city on the continent is provided by nature with such a filter, and no city could afford to duplicate it. When nature has provided such a magnificently covered filter as this great bed of porous limestone to clarify and purify the water used by its people, those people cannot afford, with due regard to their own health and welfare, to disregard it.

It may be that the supply of water, obtained from the wells sunk into this natural filter basin, is insufficient for a city of the size to which Winnipeg will certainly grow, but it would be well to determine, if the fact has not yet been determined, whether such insufficient supply is the fault of the inefficiency of the natural filter, or whether, as is much more likely to be the case, it may be caused by an inadequate supply of water to the bed of porous limestone which forms the filter.

If the supply of water available from the wells is inadequate could it not be increased? Could not the lakes and streams which now drain the water from the country to the northwest be diverted into this great natural filter, or even would it not be possible to divert some of the water of Lake Manitoba itself into it?

These questions are worth deciding before the present methods of obtaining pure water from artesian wells is abandoned.

J. B. TYRRELL,
Consulting Geological Engineer.

Toronto, March 31st, 1914.

* * * *

Jointing of Water and Gas Mains.

Sir,—I notice a letter in your issue of the 26th inst., by "Hydraulic Engineer," on "Jointing of Water and Gas Mains."

In regard to his remarks on steel pipe my own experience may be of interest.

I have laid for the Montreal Water and Power Company something over 8 miles of steel main in 60-in., 48-in., 36-in. and 30-in. diameter, and from 7/16 in. to 5/16 in. thickness for working pressures ranging from 200 to 65 lbs. per square inch.

The first mile of 36-in. was laid with a single rivetted butt strap joint. This was found to be a nuisance and expensive to lay as the joint made at the mill (the strap being rivetted to each 30-ft. length of pipe) had to be completely gone over in the field to render tight.

The remaining 6 miles of this line was obtained in tapered pipe with a total taper in 30 ft. equal, approximately, to twice the thickness of the plate. A single row of holes was shop drilled at the end of each length and a single rivetted lap joint, made entirely in the field, thus obtained. This has proved an absolutely satisfactory joint and no trouble has been experienced even with pressures up to 250 lbs.

The high pressure of 250 lbs. has been recorded due to "surging" after a sudden and accidental stoppage of the pumps.

At one point in the main a crossing of the Lachine Canal occurs. This was made in flanged steel pipe, the flanges being steel angles. Experience has shown this to be a weak and unsatisfactory joint, difficult to get tight.

I have not had experience with the lead yarn spigot or faucet joint in steel pipe, but would doubt its durability at high pressures and in large sizes.

F. H. PITCHER,
General Manager and Chief Engineer,
Montreal Water and Power Company.

Montreal, March 31st, 1914.

* * * *

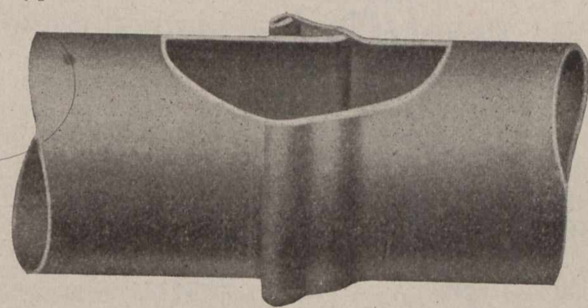
"Jointing of Water and Gas Mains."

Sir,—It is unfortunate that your correspondent "Hydraulic Engineer" did not take a little trouble to become acquainted with the actual facts of the case before making such statements as appeared in his letter in your March 26th issue. Certain of these statements are so misleading that it may interest you to have the exact position placed before you.

Your correspondent states that the process of oxy-acetylene welding is so expensive and difficult to perform, that it can be discarded as not practicable. To the contrary, the new process of welding joints is an acknowledged success, and it may interest your readers to know that orders and repeat orders have been received from about thirty gas and water companies in Great Britain, where, if anywhere, the engineer is most conservative in his ideas. To give one special instance: The City of Birmingham has installed about three miles of 9-inch pipe with this patent joint for gas work, and the probabilities are that many repeat orders will be secured from the same source.

The article in your recent issue on this new process of welding joints gave an account of the effect of expansion, and perhaps your correspondent will be good enough to read that over, so as to improve his ideas on the subject.

Another point to which exception can be taken in your correspondent's remarks is the type of sockets which he advocates for pipe lines. The consensus of opinion of engineers is strongly in favor of the following type:



The reinforced bell end removes any danger of splitting of the pipes during the caulking operation, and the turned-up spigot makes it impossible to draw the pipes apart after they are joined with lead and yarn. There is, also, a very deep groove in the socket for lead, which is a feature wanting in the special type of sockets shown in the sketches in your article of last week. The extensive mileages of pipes with this type of socket now in use can verify its popularity with engineers.

It is hoped that the above remarks will now make matters quite clear to your correspondent as they can be proved by actual fact.

A. HUTCHISON.

Montreal, March 30, 1914.

NEW SURVEYING ACT FOR SASKATCHEWAN.

The old Land Surveyors Act has given place in Saskatchewan to an act passed at the recent meeting of the Legislature of that province. The new legislation differs from the old principally in that the examination of all candidates desirous of obtaining a commission as an S.L.S. is now placed entirely in the hands of the Saskatchewan Land Surveyors' Association. This association is now placed on the same basis, and will receive the same recognition as other professional associations. It is now necessary for Saskatchewan land surveyors desiring to practise in the province to conform to the requirements of the association respecting registration.

The recently-issued report for 1913 of the city of Vancouver gives the following mileages of improvements in the city at the close of the year:—Permanent street pavements, 51.453 miles; permanent lane pavements, 3.213 miles; streets, rocked, 146.556 miles; lanes, rocked, 25.050 miles; cement concrete sidewalks, 202.184 miles; sewers, 170.01 miles; water mains, 298.84 miles.

HYDRO-ELECTRIC POWER DEVELOPMENT AT WASDELL'S FALLS.

The sixth annual report of the Hydro-Electric Power Commission of Ontario contains a section devoted to water-power investigations that are being carried out by the engineers of the Commission on a number of rivers throughout the province. Among them, the one farthest advanced at the present time is

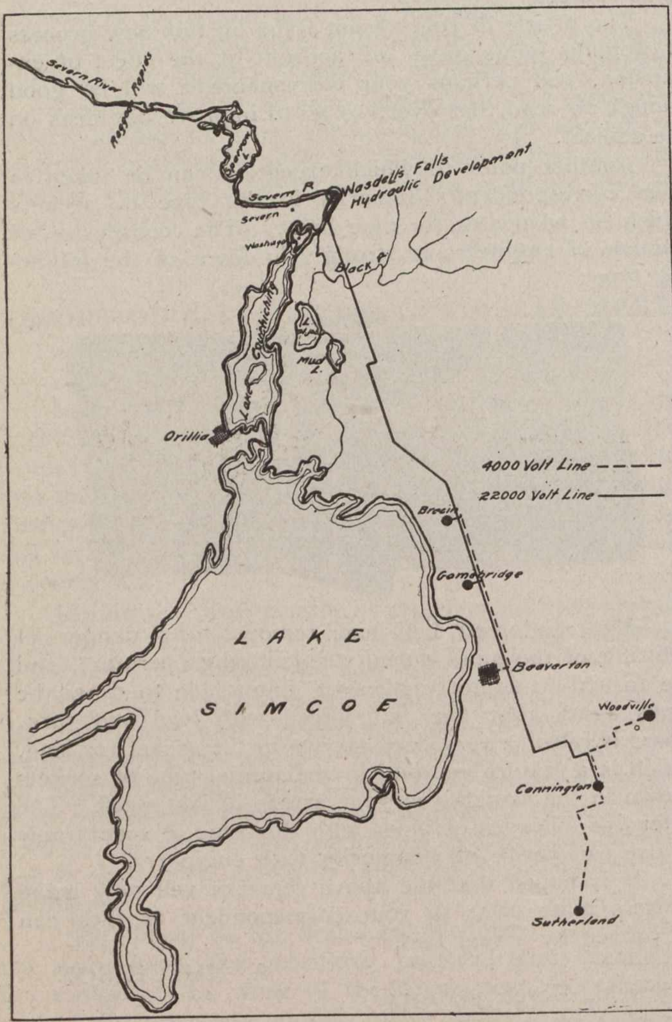


Fig. 1—Wasdell's Falls Development, showing Location and Projected Transmission Lines.

the development at Wasdell's Falls on the Severn River. There power studies are all carried out under the direction of Mr. F. A. Gaby, Chief Engineer of the Commission; by Mr. H. G. Acres, hydraulic engineer, and Mr. T. H. Hogg, assistant hydraulic engineer of the Commission. The information contained in their reports on the Wasdell's Falls project includes the following:—

The drainage area of the Severn River above the power site at Wasdell's Falls is about 2,080 sq. mi. About 700 sq. mi. of this is included in the watershed of the Black River, which joins the Severn about midway between Wasdell's Falls and the outlet of Lake Simcoe at Washago, as shown in Fig. 1. The maximum flow at Wasdell's Falls, as so far ascertained from gauge records and discharge measurements, is 9,000 sec-ft., or 4.32 sec.-ft. per sq. mi. of watershed. Under conditions that will obtain in the future, it is probable that the maximum discharge will never exceed 5 sec.-ft. per sq. mi., this low figure being due mainly to the potent regulating influence of Lake Simcoe, and to a small extent to the smaller lakes in the upper watershed.

The extreme minimum flow, during the period that the river has been under observation by the Commission, was 260 sec.-ft., or 125 sec.-ft. per sq. mi. The average flow for the period from October 1, 1912, to November 1, 1913, was 2,850 sec.-ft., or 1.37 sec.-ft. per sq. mi. This was one of the driest periods on record, so that the above is a fair indication of the minimum value of mean annual flow. On this basis the ratio of maximum to average flow is approximately as 3 to 1.

The area of Lake Simcoe is about 297 sq. mi., and when the Severn section of the Trent Canal is constructed the lake will be completely controlled by regulating dams at Washago. An annual storage draft of 18 in. may then reasonably be considered available, in which event the volume of available storage will be 12,420 million cu. ft., or 284,500 ac. ft.

The plant at Wasdell's Falls is designed for a peak capacity of 1,200 h.p. The Trent Canal works are designed to hold the tail-water level at El. 698, and with the proposed head-water level of El. 712.5, about 950 sec.-ft. of flow will be required to carry the peak load. On a 75% power factor basis the average flow will, therefore, require to be 700 sec.-ft.

The available volume of storage will provide the required average flow for 207 days in each year. Leaving an ample margin for unavoidable waste and inefficiency of operation, it is, therefore, evident that a sufficient supply of water may be anticipated at all times.

The power site at Wasdell's Falls is the only source of power from which the municipalities of Woodville, Sunderland, Cannington, Beaverton, and Brechin, may be economically served. These municipalities, in November, 1912, passed by-laws and subsequently contracted with the Commission for the supply of 625 h.p. Detailed investigations were immediately instituted, and estimates covering the cost of delivered power were submitted to the municipalities and found acceptable. The Commission, acting under authority of the Power Act, obtained an Order-in-Council covering the purchase of the site and the development of power at Wasdell's Falls, and early in 1913, work was begun upon plans and

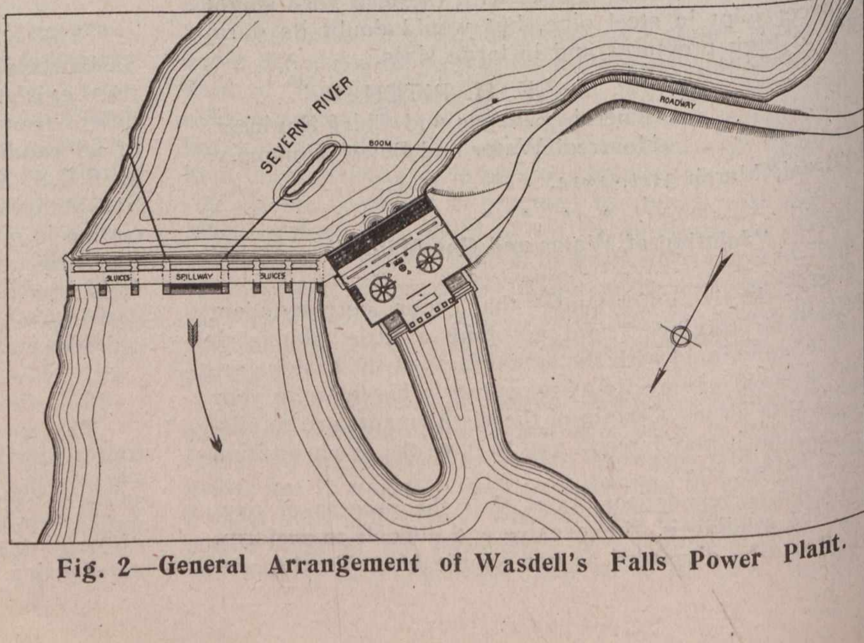


Fig. 2—General Arrangement of Wasdell's Falls Power Plant.

specifications for the hydraulic portion of the plant. Fig. 2 shows the general layout of the development, and Fig. 3 is a cross-section illustrating the power-house arrangement.

Tenders for the construction of the dam and power-house and for the hydraulic equipment were called for in

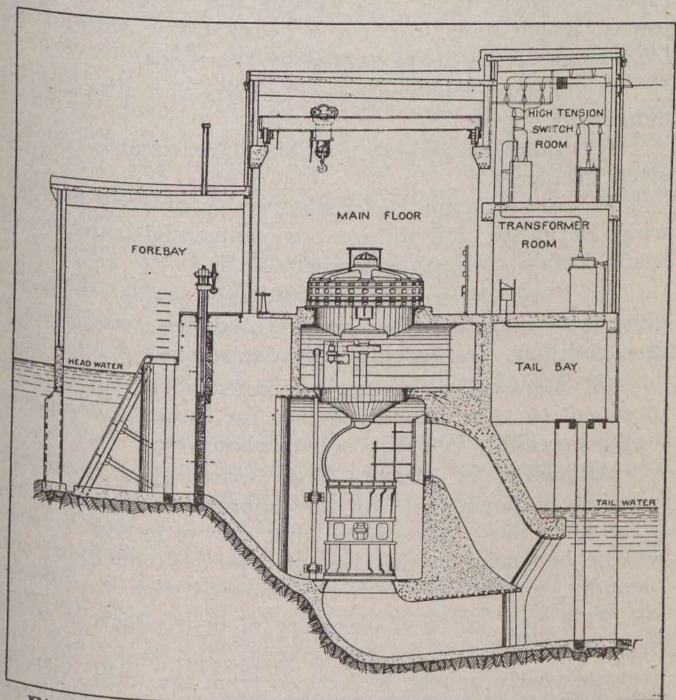


Fig. 3.—Cross-section of Power-house at Wasdell's Falls.

June, 1913. The various contracts awarded were dam and power-house, Galbraith & Cate, Montreal; turbines, Boving Company of Canada, Limited, Toronto; stop-log winch and head-gate lifting mechanism, Wm. Kennedy & Sons, Owen Sound; crane, W. D. Beath & Son, Limited, Toronto.

As regards the dam and power-house contract, the greater portion of the month of July was taken up by

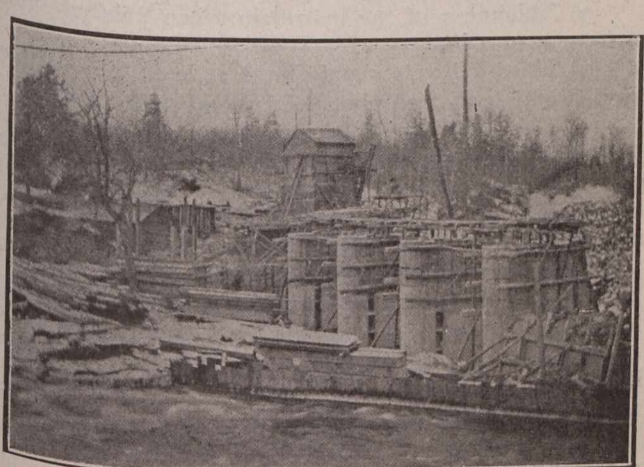


Fig. 4.—Erection of Power Plant, Piers Completed.

the contractor in the purchase of plant and the installation of same at the site of work, and it was not until the middle of August that construction work was well under way. Since that time, however, good progress has been made, and there is every reason to anticipate that under the worst conditions likely to obtain the work will be beyond the reach of the high water of 1914, and with reasonable working conditions the entire works will be completed in May, 1914. Fig. 4 is a progress view of the main dam, showing the piers completed.

The contracts entered into with the above municipalities do not by any means represent the extent of the market which the Wasdell's Falls development will serve. It is confidently expected that a large rural load will be developed in the agricultural townships of Mara, Thorah and Brock, and that the demands of these townships will practically double the present contracted load.

Apart from the low head, the topographical conditions at Wasdell's Falls are favorable for development purposes, and the value of the site as a source of power will be doubled when the dams incidental to the Trent Canal construction are built across the outlets of Lake Simcoe at Washago, which is less than three miles above the plant, making the immense storage capacity of Lake Simcoe during available low-water periods.

FOREST PRODUCTS' LABORATORIES EXPAND.

The Forest Products' Laboratories, instituted last autumn by the Dominion Government in conjunction with McGill University, contemplates the enlargement of the department, and has applied to the university for the use of another building. The McGill authorities are quite agreeable provided that the Forest Products' Service is able to repair the building in such a way as to make it a safe place for the headquarters of the new department, until the extensive plans are carried into effect when the various exhibits and staff of the service would then be housed in one of the new buildings which may be erected.

The trouble with the building is that it is sinking in the same manner as the McGill Union buildng sank some time ago. At present it is propped up with large wooden beams and as it is erected either on the bed of the old Molson Creek or on the shifting clay or sand that has been found to be very prevalent in this locality, it would be a big job to dig down to rock bottom and put a new foundation under the building.

PORTABLE METAL BUILDINGS.

Metal buildings have always been much better than wood structures for contractors on railroad and other engineering work, owing to safety, convenience and other favorable factors which their use assures. The new all-steel and metal-clad buildings now being made by the Pedlar People of Oshawa, Ont., make it possible for contractors and others to equip themselves with metal buildings with the maximum of convenience and ease of erection. They are made of Toncan metal, and are portable. They are very handy, and are especially in demand for railway work, as tool houses, shelters, oil stations, freight and wharf sheds, lamp and storage houses, etc. A very favorable feature of these buildings is that they can be added to in 8-ft. lengths at any time. They resist fire, corrosion, thieves, vermin, etc., with reliability and assurance.

QUICK COMPUTATION OF WEIGHTS OF BARS.

To find the weight of square or flat iron or steel bars, "Iron Age" suggest's multiplying the sectional area of the bar by 10/3, which will give the weight in pounds per lineal foot. Add 2 per cent. for steel. For example, in the case of an iron bar 1½ x ½ x ½ inches:—

3/2 × ½ × 10/3=5/2 or 2½ lb. per lineal foot.

For steel, add 5/100=2.55 lb. per lineal foot.

In the case of round steel bars, to find the weight per lineal foot, divide the square of the number of quarters of an inch in diameter by 6. For example, in the case of a steel bar ¾ inch in diameter:—

3 squared (three being 3 quarters)=9 divided by 6=1½ lb. per lineal foot.

SOME GOOD ROADS, THEIR CONSTRUCTION AND MAINTENANCE.

By Robert C. Muir, C.E.,
Mackenzie, Mann and Company, Toronto.

ONE of the chief requirements of our advanced civilization is good roads. This is proved by the growing demand for them. The excellence of the Roman roads still existing in various parts of Britain is direct proof of the high state of civilization to which the ancient Romans had attained, and it is admitted that no more reliable evidence can be given as to the condition of a people than that evinced by the quality of their roads, experience teaching that social, industrial and commercial development depend largely upon them.

Everyone interested in the question realizes that manufacturers, merchants and farmers save thousands of dollars through being able to haul their products to markets over an improved highway. This, the author considers the best reason for spending money on good roads.

The chief factor at the present moment is, Where is the money to come from to build and maintain good roads?

For reference the author will here explain the method employed by the Imperial Road Board of Great Britain for raising and apportioning money.

Imperial Road Board of Great Britain.—It was constituted under the Development and Road Improvement Funds Act, 1909.

The money derived from motor spirit duties and motor car license duties, imposed by the Finance Act (1909-10) is as follows:

Motor spirit excise duty of 6c. per gallon.

Manufacturer's license $4.85		Additional excise
Dealer's license $4.85		duty of $1.25 each.

Rates of Duties on Motor Cars.

Motor cycles and bicycles	$ 4.85
Motor cars not exceeding 6½ h.p.	9.70
Motor cars exceeding 6½ h.p. but not exceeding 12 h.p.	14.55
Motor cars exceeding 12 h.p. but not exceeding 16 h.p.	19.40
Motor cars exceeding 16 h.p. but not exceeding 26 h.p.	29.10
Motor cars exceeding 26 h.p. but not exceeding 33 h.p.	38.80
Motor cars exceeding 33 h.p. but not exceeding 40 h.p.	48.50
Motor cars exceeding 40 h.p. but not exceeding 60 h.p.	101.85
Motor cars exceeding 60 h.p.	203.70

The above-mentioned sums go to Road Board less cost of collection. The sum credited to the Road Board improvement fund for years 1909-10 and 1910-11 aggregated $5,806,720.

In 1910 the Road Board issued a circular as follows: "For guidance of highway authorities who contemplate making application for grants, the Board desires it to be understood that, at the outset, applications should be confined to those of the most important and urgent nature, and that special consideration will be given to those in connection with proposals dealing with:

(1) Reconstruction of important roads, the condition of which is exceptionally bad and cannot be improved without reconstruction.

(2) Widening of important roads which are dangerously narrow.

(3) Surfacing with granite, basalt, or other suitable material treated with tar or other bituminous compound by some approved method, main roads or important district roads which already have adequate foundations, especially those in or just beyond the fringe of large towns, which have to carry a heavy traffic without aid from rates of the towns served by the roads.

(4) Opening out dangerous corners and alteration of dangerous curves.

(5) Alteration, where possible at reasonable cost, of steep gradients.

(6) Strengthening or reconstruction of weak bridges, which seriously limit the use for commercial transport of roads of first class importance.

(7) Construction of new by-pass roads to avoid villages or main roads or important district roads where the conditions are exceptionally dangerous.

(8) Acquisition in urgent cases where building is imminent of vacant land required for future widening of roads, especially in urban or suburban areas.

Allocation of Grant.—The Board goes upon the principle of paying 75% of any approved scheme. First of all they must be satisfied that any proposed scheme will be beneficial to the through users of the road, and secondly, to the local authority charged with its upkeep.

This 75% is of the portion of cost which is extra over the ordinary yearly upkeep, that is to say, the average yearly upkeep is deduced from the total estimate of the scheme; then the Board pay 75% of the remainder.

This is the general principle with all county authorities, but the Board is not so generous with municipalities, where a grant of 25 to 35% is only occasionally allowed.

Specifications of Road Board.—The Board gives specifications for surface tarring, tar macadam, pitch grouted macadam, and No. 1 and No. 2 tars.

Tar Macadam Specification.—(1) Roads must have proper foundation.

(2) Thickness of surface should be ascertained by opening roadway.

(3) Thickness of tar macadam when finished should be from 2 to 3 in.

(4) Hard subsoils should have at least 6 in. of road crust foundation, and clay subsoils at least 11 in.

(5) Cross fall should be 1 in 32.

(6) The aggregate of the tar macadam should be of approved stone, at least 60% broken to 2½ in., 30%, 2½ to 1¼ in., and 10%, ¾ to ½ in., the last-mentioned to be kept separate and used as top dressing.

(7) The stone to be dried before coating with tar.

(8) Tar to be in accordance with Board's specifications Nos. 1 or 2.

(9) The quantity of tar to be from 9 to 12 gallons per ton.

(10) To be rolled smooth.

(11) Paint surface with tar after road has been open to traffic for some weeks.

(12) Surface to be gritted with ¼ in. chippings.

Specification for Tar No. 1.—Tar should be treated to a temperature of 220° to 240° F. It should be derived from the carbonization of bituminous coal.

The specific gravity at 15° C. should be 1.19 or may vary from 1.16 to 1.22.

It shall not contain more than 1% of water, which water shall not contain more than 5 gr. of ammonia per gal. of tar.

Specification for Tar No. 2.—Tar should be heated to 260° to 280° F. It should be derived from the carbonization of bituminous coal. Specific gravity at 15° C. should be 1.21 or may vary from 1.18 to 1.24. The tar shall be free from water and shall yield no distillate below 140° C., nor more than 3% of distillate up to 220° C. Between 140° and 300° C. it shall yield not less than 15%, nor more than 21% of the weight of the tar.

At this point it might be convenient to mention that in Great Britain there are over 231,000 miles of roads, some of which, it is said, are the finest in the world, and for which the cost of upkeep in 1892 was $42,500,000. But last year (1913) the cost of upkeep was over $90,000,000. The number of motor cars is estimated at 240,000.

Various Kinds of Roads.—The engineer's problem of to-day is how to build and maintain good roads.

Macadam Roads.—These, when properly built and maintained, form the safest, pleasantest and cheapest road surface known for suburban streets and country roads.

The Telford and Macadam methods have given best results in a rather wet locality where the water has aided in binding the materials, and its removal by drainage of the roadbed and surface was the most important point in the maintaining of a good road. The said methods carried out in a locality having little or no rain, drainage is unimportant, and the preserving of a well-bonded surface is of the greatest importance. This bonding may be secured with a bituminous binder.

Points to be observed in construction of macadamized roads:

(1) The removal from roadbed of all vegetable matter.

(2) Subsurface drainage.

(3) Use of the very best material afforded by locality, and if traffic warrants it, the importation of suitable material.

(4) Classification of stone, 2½ in. down ½ in. chippings.

(5) Complete exclusion of loam and clay from stones.

(6) Use of stone dust and screenings, same quality of stone used to fill interstices.

(7) Thorough consolidation of stone by using a 10-ton steam roller.

Quality of Stone.—The material used for this class of road must naturally vary according to locality. Local stone, owing to cost of haulage, must generally be used. Should the traffic be excessive it will be found more economical to procure a superior stone, even at a greater cost than the local stone, in all cases where traffic is great, the best material obtainable is the most economical.

The qualities required are toughness and hardness—ability to resist the breaking up action of the weather.

A well-made and formed limestone road will be more impervious to wet than any other, having a detritus which acts like mortar in binding stones together and will not break up so soon in dry weather. Hardness without toughness is of no use, as a stone can be hard, yet so brittle as to be crushed to powder under a heavy load, when a stone not so hard but tough will be uninjured.

The author advocates the rolling of foundation and of each coat or layer of stone, the finished surface to be of chippings and dust of same quality of stone used, this to be watered and rolled until consolidated.

Watering.—Water expedites the consolidation, lessens crushing under the roller, and aids the filling of interstices with binder. The spray should be fine, a sprinkler being used, and not thrown on in quantity or by use of hose. Excessive watering tends to soften foundation and great care should be taken in applying it.

Rolling.—A steam-roller has proved to be the most economical. There is no rutting by wheels of vehicles, or holes wherein water can lodge; resistance is reduced to a minimum, saving wear and tear of horses and vehicles, and comfort of people using the roads. Roads should be made for the traffic and not by it. The use of a 10-ton steam roller for all purposes except asphalt construction, is strongly advocated.

Breaking of Stone.—Stone should be broken by hand, a practice which finds favor with many engineers in Britain. With this method of breaking, stones are more uniform in size, have sharper edges, are not flaky with rounded edges, and are therefore better for compacting. The installation of the machine breaker or crusher has effected a great saving in cost and also increased the output considerably.

In Canada, where labor is very expensive, the breaking of stone by crusher is undoubtedly the best method. The hand-breaking method, though the best, is very expensive. The wear and tear of crusher and also the initial cost are very great.

To be a paying factor, the crusher must be kept in almost constant use. Great care must be taken in feeding and must be placed so as to reduce to a minimum the cost of handling the broken and unbroken stone.

In many places a fixed plant is used for crushing, the stone being brought to the crusher. The haulage in this case may be very great, which increases the cost considerably. It is, therefore, generally more economical to take the crusher to the stone, and this is done by having a crusher of portable type and using the steam-roller to haul it.

Surfacing of Macadam Roads.—The methods employed in re-surfacing are:

(1) The surface is cleared from dirt and new stone spread on and rolled in the same manner as a new construction.

(2) The surface is scarified before new stones are spread on.

The object of this is to enable the new stones to become more compacted with old material.

As to its advantage much difference of opinion exists. Some engineers maintain that it is not good to touch the compacted surface for the questionable advantage of securing better union of old stones with new. Others are of the opinion that the surface should be scarified, the stones sorted and cleaned, and relaid with the addition of new stones. In deciding which of these methods should be adopted it is necessary to consider all the circumstances. The thickness of existing surface and nature of roadbed must be considered. In the case of a thick surface, the surface should be scarified, but great care is necessary, as should surface be broken through tc roadbed the foundation is liable to be injured.

With a thin surface and weak foundation scarifying should not be done as it is liable to make the road weaker than before. The author having had experience in both methods has had good results from each, though he is in favor of not disturbing the existing surface, which is the general principle carried out in Britain.

Maintenance of Macadam Roads.—The opinion that no road is a good one unless when once laid it will take care of itself is ridiculous; there is no such road. The essential point in the preservation of a good surface is the vigilance on the part of road authorities. Should a depression appear in consequence of settlement, defective material, or other causes, it should be immediately eliminated. Best results are obtained and money is saved by immediate repairs on the road surface rather than leaving it until practically worn. Roads must be kept clean and, if possible, dustless.

When a road is finished and opened to traffic, it cannot be left to take care of itself; if so, it will soon deteriorate. The systems of maintenance in vogue are: (1) Contract; (2) personal supervision by rural population; (3) men employed by road authorities.

The author is in favor of the system of the work being done by men employed by the authorities, as in his opinion the men become familiar with the section under their supervision, and also seem to take an interest in the work, doing their very utmost to keep road clean and tidy. This is the system carried out in Scotland and other European countries, and it is to the thorough appreciation of this fact that the excellence of their roads is due.

The contract system is very unsatisfactory from the difficulty of getting a proper observance of the terms of the contract from contractor; this system has been tried in many places and has never given satisfaction.

The personal supervision by rural population or the statute labor system is not applicable to the upkeep of improved roads. It is unsound in principle, unjust in its operation, wasteful in its practice and entirely unsatisfactory in its results.

The rolling of a road in spring, after frost is out and before roadbed is dry, is one of the best means of keeping a macadam road in good condition. As before mentioned, great care must be exercised in watering and a road should not be watered unless it really needs it.

Macadamized Road with Tar Binder.—The tar binder has given good results, producing a road almost similar to an asphalt surface, almost noiseless, less wear and tear, less mud and dust than ordinary macadam.

Asphaltic oil has been used in many places as a binder for macadam roads and in very dry climates has given satisfactory results. The following method is employed: The existing surface of the road is covered with coarse sand of ½ in. thick. The oil heated to a temperature of 175° F. is then applied and is allowed to remain for 24 hours. This surface is then covered with ½ in. of sand, and oil again applied. This surface is immediately covered with sand sufficient to fill the liquid oil and remove stickiness. The surface is then rolled. Should surface lift under this treatment a little sand is applied again.

One of the first experiments tried by the author was treating of road surface with ordinary gas-works tar. This certainly kept down the dust and as a surface binder was fairly successful. But in hot weather it was continually running, and was more of a nuisance than otherwise.

Another method tried and highly successful as a dust preventative: calcium chloride was mixed in the proportion of 1 cwt. chloride to 100 gallons of water, and the mixture sprayed on to the road. This material served the purpose well, the absence of dust within a given period (almost three weeks) being the subject of favorable comment by residents. The cost worked out at 25 cents per mile for chemicals only.

A thin coat of tar of under-mentioned specification gives a fine surface in dry weather, but becomes dirty in wet weather under heavy traffic. During summer this method is very successful if used on streets under light traffic.

Specification: Specific Gravity—1.19 at 60° F.; Water—free; Fractionation—not more than 3% at 220° C., 15 to 20% at 300° C.; Free Carbon—15%; Viscosity—30 sec. at 70° F. The cost of this treatment was 5 cents per sq. yd. One gal. of tar covered 5 sq. yd. of surface.

A few years ago the author had a section of road treated with Tarvia "A," which was an exceptionally heavy tar. This road surface was in every way good, very regular in shape. The method was carried out in the following manner:

1st, Surface of road was thoroughly cleaned and swept free of dust; 2nd, the tar was heated and spread on road by means of sprinkling cans; 3rd, chippings of same quality of stone used on existing surface, which was very gritty, ½ in. to ¼ in. in size, free from dust, was spread on surface; 4th, the surface was then rolled with a 10-ton roller. The section treated was opened to traffic a few days after completion. The quantity of tar used was ¾ gal. to 1 sq. yd. of surface. The following year a similar treatment was applied, with the exception that the quantity of tar used was ¼ gal. to 1 sq. yd. of surface. This treatment gave excellent results, openings made in road a few months after second treatment showing that tar had really penetrated the surface to a depth of one inch, which greatly helped to bind the surface. It may be mentioned that this section did not get quite a fair trial as traffic conveyed upon it mud and dust from either end of the section, which caused a little more sweeping and watering than was necessary.

Before applying the tar the surface of road must be thoroughly cleaned, all dirt being removed so as to expose the stone surface. Should the surface not be cleaned in manner mentioned, or any cakes of dirt be allowed to remain, the tar will not penetrate into the macadam.

Surfacing with a substance called "Cormastik" is another method which has proved satisfactory. It is composed of ¼ in. to ⅜ in. granite chippings, sharp sand, powdered sicilian rock asphalt containing 10% of pure bitumen and Portland cement. The binder employed is Cuban natural asphalt refined and suitably fluxed. The existing surface of road having been thoroughly swept and cleaned and painted with the bituminous solution. The "Cormastik" is then spread in a heated state to a thickness of one inch, a wooden straight edge being used for levelling, and finally rolled to a smooth surface by a 3-ton tandem roller.

This surfacing is also made up in brick form 9 x 4½ x 2 in. thick laid on a concrete foundation and suitable for heavy traffic.

Pitch Grouted Macadam.—The size of stones used was 2½ to 1¼ in. with chippings from ¾ to ⅜ in., the finished thickness being 3 in. The stone, spread and levelled, is rolled dry until proper surface has been formed. The pitch, after being melted, is heated to a temperature of 300° F. Clean, sharp sand is added to this, mixed thoroughly in mixing vessels and transferred from these into cans, from which it is poured upon the road. On this surface a thin layer of chippings is applied. The quantity of pitch used was 2 gal. to a sq. yd. of surface. This method is fairly satisfactory in some districts. In the author's experience the pitch boiled out in hot weather leaving the road in dirty condition. The crown of the road became bare of pitch, the sides getting the surplus. The stones were never thoroughly coated, thus allowing water to get into the crust.

The method employed in one instance was a double layer. The size of stones used for the lower layer was 3 to 2 in. and for top layer 1½ in. with ½ in. chippings. The lower layer of stone is spread and levelled and is rolled dry. The pitch and sand mixture (as above described) is poured on, but not brought to surface. The pitch lying ½ in. or so below surface of the lower layer to form a key for top layer.

When the top layer has been laid, the pitch mixture is poured on surface, which is rolled and consolidated to proper shape. During rolling chippings are applied to form finished surface.

The quantity of pitch mixture used was 3½ gal. per sq. yd. for the two layers. The finished surface in this case was 4½ in. thick. This method was very satisfactory during the year, almost dustless, and not slippery during frost.

(To be concluded next week.)

ELECTRICAL DRIVING OF WINDING ENGINES AND ROLLING MILLS.

In a very complete and well-illustrated paper, delivered last month to The Canadian Society of Civil Engineers and to the Canadian Mining Institute, C. Antony Ablett, A.M.Inst.C.E., and H. M. Lyons, A.M.I.E.E., described the use of electrical machinery for driving hoisting engines in mines and reversing mill plants in steel works.

The first winders of importance were introduced in 1902, and the first electrically driven reversing rolling mill was installed in 1906, though non-reversing rolling mills were driven electrically some eight or ten years earlier.

The developments along these lines have been extremely rapid, as is shown by the fact that at the present time about one thousand large winding engines and nearly sixty reversing rolling mills are being driven electrically. The earlier winding engines were extravagant in power and had the disadvantage of drawing very heavily upon the source of electrical supply at the moment of starting. It was, therefore, impossible to use them on systems where the supply of current was limited, and even on comparatively large plants their use resulted in serious interference with other machinery. These disadvantages were, however, practically done away with when the Ward Leonard system and Ilgner's adoption of the flywheel to this system were introduced, but the last few years have seen greater improvements in the Ward Leonard and the Ilgner system.

The paper delivered by Messrs. Ablett and Lyons dealt chiefly with the developments of these systems by the various Siemens companies, who have installed about half the total plants in existence, and with whom the authors are associated, as general manager and assistant manager, respectively, of Siemens Company of Canada, Montreal. Following is a very brief abstract of the paper:—

In the Ward-Leonard system a direct current motor is used to drive the winding engine or rolling mill, the motor being supplied with power from a direct current dynamo, and the essential feature of this system is that the voltage supplied to the motor, and consequently the speed of the motor, is controlled by controlling the field current of the generator, instead of by varying the resistance in the armature circuit of the motor.

Thus, as the field current of the generator is increased from nothing to a maximum, the motor speeds up from standstill to full speed, and if the field current of the generator is reversed, the motor reverses its direction of rotation.

This system enables a very exact control of the speed to be obtained, because the speed of the motor is practically proportional to the strength of the generator field, whatever the load on the motor may be, while with any control system where resistances are inserted into the armature circuit of the motor, the speed would vary within very wide limits with a change of load, rendering the exact speed control quite impossible.

The control of the dynamo field involves scarcely any waste of electrical power, but where resistances are inserted into the armature circuit the loss of power may be, and usually is, very great. The field currents of the generator are small, so that the control mechanism is small, compact and very easy to handle, the armature currents are perhaps fifty times as great, so that any control mechanism which varies the resistance of the armature circuits is large, clumsy and difficult to handle, in fact a complicated relay system is often necessary to enable it to be handled at all.

The dynamo used to supply the motor in the Ward-Leonard system is usually driven by a motor supplied from the available power circuit, forming a motor generator set, and this motor may be either direct current or three-phase, according to the power available. The dynamo may be, and sometimes is, driven by an engine, water turbine, or other prime mover, if this happens to be more convenient.

The paper gives a full description of the application of the Ward-Leonard system to winding engines and hoists under the titles of Speed Control, Use of Flywheel, Details of Ilgner System, Brake Gear and Safety Devices.

It also describes the application of this system to reversing and three-high rolling mills, discussing power diagram for reversing blooming mill, action of flywheel, safety devices, etc.

A three-phase motor cannot be built for a very low speed without its power factor being bad, which tends to upset the regulation of the supply system, and for this reason where three-phase motors are driving winding engines they nearly always run at higher speeds than the drums, and are geared to them. In the Ward-Leonard or Ilgner system, however, where a direct current motor is used, this is almost invariably direct coupled to the drum. The three-phase system was described under the following headings: Control, Power Diagram of Three-Phase Winder, Comparison of Three-Phase Winder with Ward-Leonard and Ilgner Winders, Lowering Load, Starter and Controlling Resistances, Emergency Gear, Winding Men and Shaft and Rope Inspection.

As a number of winding engines have been equipped with three-phase commutator motors, an account of that system is also given.

The conditions governing the selection of the type of drum differ very considerably, according to whether the winder is to be driven electrically or by a steam engine. It is characteristic of the steam engine that its overload capacity is not very great and that the turning moment varies according to the position of the cranks. For a two-cylinder engine with cranks at right angles, such as is usually used for a steam winder, the minimum turning moment is .785 of the mean turning moment, and the maximum turning moment is 1.112. The engine naturally must be able to start the hoist with the cranks in any position, so that the minimum turning moment must be at least sufficient to overcome the static load and friction. An electric motor, on the contrary, has a very large overload capacity in proportion to the mean power which it will give, and, consequently, the motor for winding engines is usually selected with reference to the equivalent continuous load, and it is very rarely indeed that the starting moment or acceleration peak needs to be considered.

The first type of drum to be employed for winding engines was the cylindrical drum, but later the conical drum was introduced. In some cases the latter gives easier starting conditions and is beneficial to the steam engine, because the rope supporting the cage at the bank top is wound off the greatest diameter, while the rope attached to the loaded cage at the pit bottom is wound on to the least diameter, so that the empty cage partially balances the rope and the loaded cage at the start of the wind.

The Koepe pulley winder is used to a considerable extent in Europe, particularly in Germany. It differs from any other type, as the rope is not wound on to and off drums but is carried over the pulley and makes contact with it for less than a single turn. Thus the rope from the ascending cage comes up the shaft over the driving pulley by the winder, and then down to the descending cage, being suitably guided by head sheaves.

It will thus be seen that the winding rope is driven by friction alone, and, consequently, there must be a very definite limit between the pull in the ascending rope and the pull of the descending rope, otherwise the rope will slip on the pulley, and, to keep the difference in pull of the two sides of the rope as small as possible, a balance rope is always necessary.

It should be noted that such a winder cannot work with a very high acceleration, otherwise slipping of the rope will take place. As the rope is bound to creep on the pulley to a certain extent, the depth indicator must frequently be reset to ensure its accuracy.

As with a Koepe pulley winder the axial length of the pulley is very short indeed compared with that of a drum on which the rope has to be wound, and as the weight of the winding drum is not increased by the rope which it is carrying, the moment of inertia of the revolving parts of a Koepe pulley winder is small, and this, together with the use of the balance rope, keeps the maximum acceleration peak comparatively small compared with that of other types of winder.

Generally speaking, the Koepe pulley winder shows to the greatest advantage with deep shafts as it avoids the use of excessively long drums, and, from the electrical point of view, where the winding speed is not very high and where the acceleration period is short compared with the total time of winding. It has the disadvantage that if the rope breaks, both cages are detached from the winder.

Table Showing the Influence of the Different Types of Drums on the Electrically Driven Winding Engine.

Depth —1,600 feet. Output—270 tons per hour.

	Cylindrical Drum	Conical Drum	Scroll Drum	Koepe Pulley
Power of motor	1,090	965	780	935
Speed of motor	84	66	62.7	97
H.P. per revolution ..	13	14.6	12.4	9.6
Maximum peak with Ward Leonard system	1,865	1,690	1,390	1,276
Average loss of power with three-phase system	325 H.P.	260 H.P.	170 H.P.	341 H.P.

Generally speaking, the authors are of opinion that the Ward-Leonard or Ilgner system of electric winding is the most suitable for vertical shafts, and for all cases where large outputs are required and short and frequent winds are made. The three-phase winder always has the disadvantage that it cannot be so completely protected against careless handling as either the Ward-Leonard or the Ilgner, but it may prove more economical for long slopes where the full speed run is a long one and the periods of acceleration are comparatively infrequent.

Regarding the choice of drums for the winding engine, the authors are of opinion that in many cases where electrical drive is adopted, the cylindrical drum winder will prove the most suitable, but that in cases of deep shafts where the winding speed is high the scroll drum winder may prove better than the cylindrical drum winder, but that the field of application of the conical drum winder to electric winding is very small.

The authors have purposely avoided any comparison between the running costs of a steam and an electrically driven hoist or rolling mill, because each case should be considered on its own merits and comparisons made for one case will not be valid for another where conditions are different. No general comparison has any practical value, sometimes the steam engine is the more economical, and sometimes the electrical plant, according to conditions, and in deciding which is the more advantageous there are other factors besides running costs to be considered.

The authors are of opinion that direct current is much better adapted for driving mills and machinery in a steel works than three-phase current. Where large reversing rolling mills are driven electrically, and the motor driving the motor generator set is supplied from a direct current system, it is found that the power supplied to the rolling mill plant can be maintained at a much steadier value than if it is supplied from a three-phase system, and with the direct current motor about a ten per cent. saving in power can be effected, as there is no loss of power in slip resistances.

With a direct current system the flywheel of the motor generator set can be utilized to a great extent for neutralizing sudden peaks of short duration in the power demand on other parts of the system, for, during such a peak, the motor generator set would not only cease to take power from the supply, but the motor can be actually reversed, and give its full output as a generator returning the energy of the flywheel as electrical energy to the supply system.

With a three-phase system, peaks in other parts of the system cannot be neutralized to anything like the same extent, for the motor can only be made to cease to take power from the supply system and cannot act as a generator returning power to the supply system.

The direct current compound wound motor is very well adapted to fulfil the conditions for driving three-high merchant and bar mills and that considerable complication and difficulties are involved in adapting the three-phase motor for this purpose.

Direct current motors are also particularly well adapted for driving slow speed sheet and tinplate mills, and it is very easy to provide a slow speed direct coupled motor and gain the advantage and economy of this drive, and, as there is no loss of power in slip resistances, the direct current motor will prove from twelve to fifteen per cent. more economical than the three-phase motor on this current alone.

The advantages of direct current table and live roll motors are fully recognized, but it is interesting to note that in perhaps the largest steel works on the American Continent, where the main power supply is three-phase, all the table motors are direct current and a large and costly installation of converting machinery has been provided to convert the three-phase current to direct current to supply these table motors.

It may be argued that the cost of cables with a 500-volt direct current system is much higher than for a high voltage three-phase system, but it must be remembered that a well laid out steel works is comparatively compact and the distances are relatively short, so that the cost of cables is not a very serious item, and that the additional capital cost of three-phase generating plant to produce power, which is wasted in the slip resistance, etc., will pay for a good deal of extra cable.

In steel works where there are blast furnaces and coke ovens, the modern tendency is to install large gas engines using blast furnace or coke oven gas, both for driving the blast furnace blowers and for generating electrical power, and experience shows that a direct current gas engine power house is cheaper in capital cost and easier to operate than a three-phase power house.

Gas engine driven three-phase alternators present the most difficult problem in parallel running, and while sufficient experience has been gained in the past ten years to enable these difficulties to be overcome by proper design, the provision of very heavy flywheels is always necessary, and these largely increase the capital cost of the three-phase generators, which are intrinsically more expensive than direct current generators. The higher the periodicity the heavier the flywheels for the three-phase generators become. The 500-volt direct current system has found very wide application in the steel works on the Continent of Europe.

DIESEL ENGINE EXHIBIT AT THE PANAMA-PACIFIC EXPOSITION.

It is announced by the Department of Machinery of the Panama-Pacific International Exposition that more than a dozen large firms have contracted for space in which to install engines built on the Diesel principle. These exhibits will occupy a central space in the great Palace of Machinery, and will be under operation through connection with electric generators or other machinery for the purpose of showing the efficiency and economy of working.

It will be recalled that the tragic death of Dr. Rudolph, inventor of the motor, by drowning in the English Channel, which occurred in September, 1913, was almost simultaneous with the final triumph of his ingenious motor by its adaptation to railway traction on a large scale.

NATIONAL IRRIGATION CONVENTION.

Arrangements are being made for a National Irrigation Convention to be held in Calgary next September. A fund of $20,000 is practically assured for it. The convention will bring a large delegation of irrigationists from Oregon, Washington, Montana, Idaho, Utah, Texas, California and other States. Irrigation work in Canada has created a good deal of interest in the country to the South, and the gigantic project of the Canadian Pacific Railway, as outlined in *The Canadian Engineer* for January 1st, 1914, will receive a thorough inspecting by many irrigationists who are extremely interested in the enterprise.

A detailed programme of the convention will be announced at an early date.

THE ZOELLY STEAM TURBINE.

In 1898, Mr. Zoelly designed a new type of steam turbine which resembled in many respects a water turbine of the impulse type. This machine was designed on the radial flow principle. The blades were not curved. A second machine with curved blades gave better results, however, the steam in this case striking against the rotor blades in radial direction. The principle of the impulse type has been adopted from the commencement as being the best, and the only alterations that took place were in the manner of guiding the steam onto the wheels. The turbine has gone through many stages of improvement which, however, have been solely of a constructional character. No departures from the adopted principle have taken place. On the original type the governing is effected simply by throttling the live steam and not by varying the number of channels through which the steam is admitted.

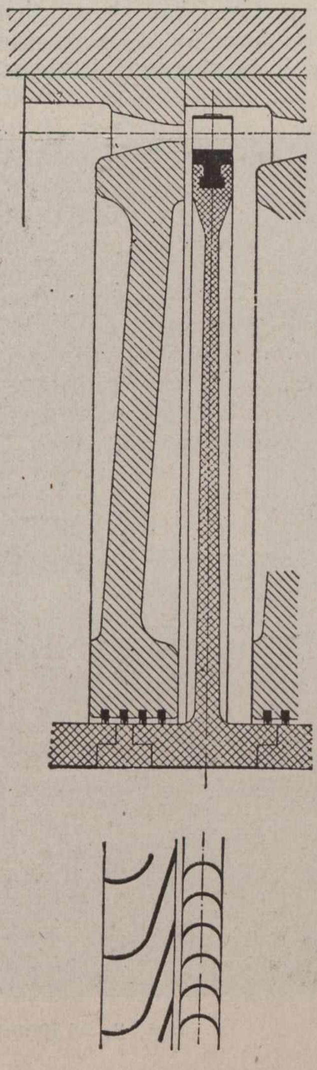


Fig. 1.—Runner and Guide Wheel of Zoelly Turbine.

This turbine has, in the past, been subjected to a good deal of criticism respecting the steam pressure and temperature in the first stage which were considered to be excessively high and which were supposed to have a deleterious effect upon the stuffing boxes. In the case of the present Zoelly turbines these criticisms are without foundation as in the first stage a greater pressure drop and likewise a correspondingly higher steam velocity is made use of than previously. This velocity equals or even surpasses that of sound corresponding to the steam conditions of this particular stage.

In order to be able to construct large units without having to employ too large blades in the last two stages, these stages are provided with a greater drop of pressure so that they also work with steam velocities which may be five and even more per cent. higher than the velocity of sound. The intermediate pressure stages work with steam velocities which do not, or only in a very slight degree, exceed the velocity of sound belonging to the conditions of these stages. At any rate, the excess of velocity over that of sound is in the intermediate stages never so great as in the first and last stages.

The total drop of pressure available has been divided up in such manner that it has been impossible to reduce the number of stages and thereby shorten the turbine by an appreciable amount. If necessary, these stages are constructed with expanded guide channels or nozzles. This expansion is not, however, designed for full load but only for about half or a quarter of full load, in order to ensure a good efficiency even at part load. Such types of Zoelly turbines have been built since 1908.

The characteristic feature of the Zoelly turbine has always been the design of the runner wheels and guide channels in the diaphragm, the former of which, in spite of the high factor of safety required, are enabled to give a relatively high circumferential velocity. Consequently greater latitude is permissible in regard to the number of stages and speed of the steam in each case.

Construction.—From the commencement the Zoelly turbine has always been constructed with a horizontal shaft; experience with water turbines has shown that by this method the simplest form of bearing can be used, permitting an easy inspection at all times. In the case of turbines running at 3,600 r.p.m. a flexible shaft is used, so that the critical speed is sufficiently below the working speed; but in the case of turbines running at 1,800 r.p.m. and under, the contrary is the case, the shaft is rigid and the critical speed is above the working speed. The shaft is supported by two bearings which are lubricated by oil under pressure, and is connected by means of a rigid or flexible coupling (usually rigid) to the generator or machine to be driven. The casing is built up in two halves, the joint being horizontal, so that the rotor can easily be inspected without dismantling the bearings. An idea of the accessibility of all the important parts can be gained from the illustrations shown.

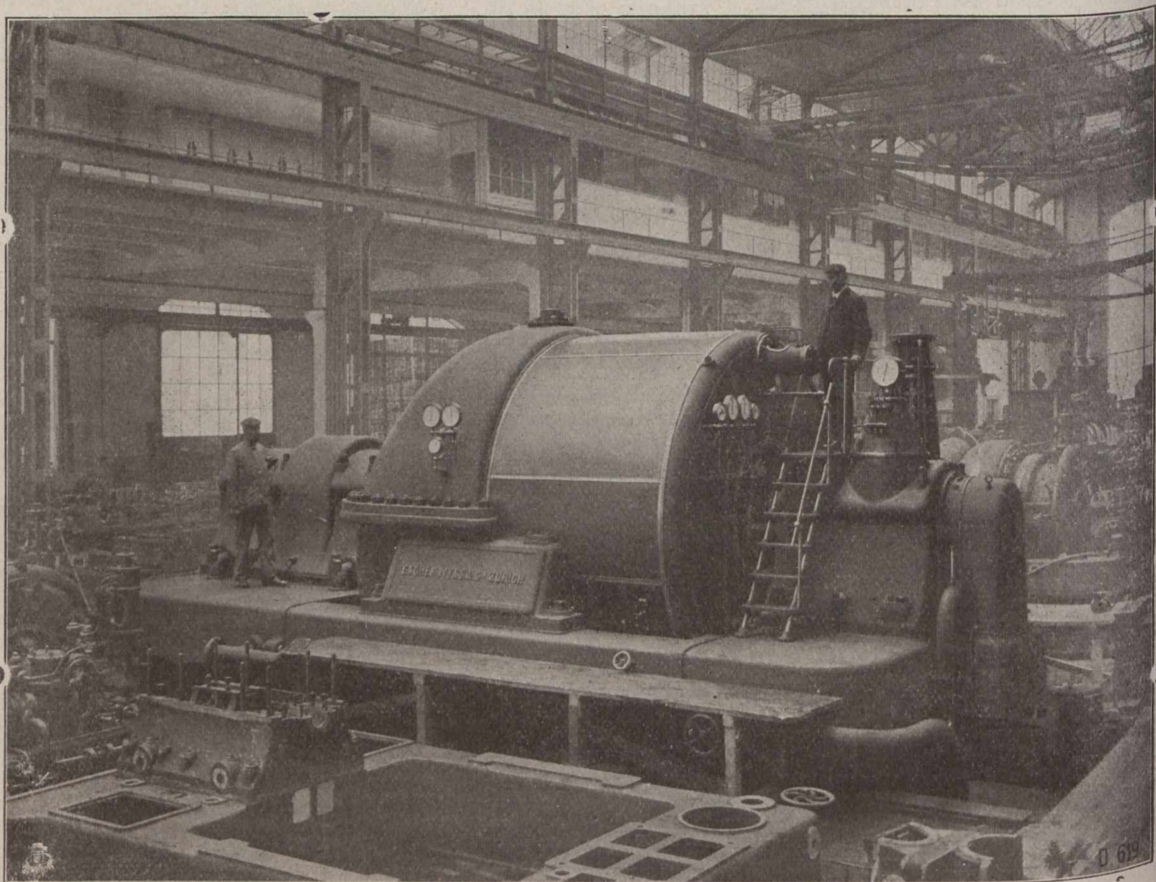


Fig. 2.—15000-kw. Escher Wyss-Zoelly Steam Turbine.

To keep the velocity of the steam low, which is possible in the simple velocity wheel, the wear in the blades, specially when working with saturated steam, is reduced to a minimum.

The impulse type allows large clearances in radial and axial direction. The axial clearances of the runner blades as well as the radial clearances are about 0.2 in. Nevertheless, the steam consumptions obtained with the Zoelly steam turbine are extremely low, particularly for the large size high-speed units.

The turbine is what can best be called a commercial machine, i.e., a machine giving with the greatest reliability best economy and least wear, with a minimum of attendance required.

The total thermodynamical efficiency obtained has been as high as 74%.

Since this turbine came on the market 11 years ago, it has done excellent work. Twenty firms are at present licensees of the Escher Wyss Company, of Zurich, who built the first machines and who have since supplied the bulk of the machines put on the market.

Up to 1913, Zoelly turbines of 3,350,000 h.p. have been supplied, of which those built by Escher Wyss and Company had a capacity of over 800,000 h.p. The largest size machine was 15,000 kw., equal to 28,000 h.p., of which two units were supplied to the Rheinisch-Westfaelisches Elektrizitaetswerk (Germany) — one in 1911 and the second as a repeat order in 1913.

A number of machines of similar size have been built for other concerns; such as, a plant of four 10,000 kw. units for the Chile Exploration Company, of New York.

The *Engineering Record* describes the recent feat accomplished in subway tunnelling in New York city thus:—"For the first time in the history of subaqueous subway construction in New York city, a radical departure from the usual methods of building the tubes in place by compressed air tunnelling methods has been made. An 8,000-ton section of four-track steel lining, 220 feet long, 26 feet wide and 24 feet deep, which had been assembled and riveted on shore, was floated out into the Harlem River and sunk into position through 60 feet of water. The enormous mass was at all times under perfect control, was handled without any surges, plunges or violent or dangerous movements, and the structure was placed in position far below the surface without the use of guides or complicated apparatus. Work was carried out strictly in accordance with a detailed schedule of time and operation, which made ample provision for all the difficult conditions under which the work was executed."

Coast to Coast

Guelph, Ont.—The bridge leading from Riverside Park to Wellington Place and to the Guelph Country Club has been formally opened.

Victoria, B.C.—The civic board of works of Victoria has prepared estimates for 1914 calling for a requirement of $1,041,136.40, a considerable increase over the outlay in 1913 of $969,427.70.

Brantford, Ont.—By an overwhelming majority Brantford ratepayers voted in favor of the purchase of the Brantford Street Railway and Grand Valley Railway from Brantford to Galt for the sum of $253,000.

Vancouver, B.C.—With an expenditure of between $15,000 and $20,000, the C., M. and St. P. Railway Company has purchased its right-of-way at Sumas preparatory to linking up its line with the B.C. Electric railway, over which rails it will enter Vancouver until its own line is finished.

Toronto, Ont.—It is reported that the first of this month is to make the commencement of operations upon the harbor development scheme in Toronto. The great undertaking will be started at Ashbridge's Bay to the east of the mouth of the Don, where three pile-drivers will be set at work, later to be supplemented by other drivers.

Hamilton, Ont.—At a recent meeting of the Hamilton Works Committee it was announced that the estimate of the Hydro Department for street lighting has been amended, the new figure being $88,125, whereas the original estimate was $64,200. It was explained that 25½ miles of streets had been added to the original estimate, and that some of these had to be lighted on both sides.

Vancouver, B.C.—Estimates recently furnished for 1914 on the partnership main between Point Grey and Vancouver, totalled $294,740, as compared with $213,394 last year. The principal increase is for submerged main maintenance. Under this head last year less than $1,000 was spent, but this year the replacing of the main on account of the government dredging is estimated to cost $100,000.

Ottawa, Ont.—On March 20, supplementary estimates, amounting to $3,257,036 for the fiscal year just ending, were tabled in the Commons by the Minister of Finance. This brings the grand total of the estimates voted for the year to almost $206,000,000. Of the supplementary estimates, the additional amount required towards the completion of public works was $264,204.

Ottawa, Ont.—The annual report of the Ottawa electric department has been recently submitted to the city council. The revenue for the year amounted to $191,648.64, as follows: domestic lighting, $68,032.27; commercial, $53,438.04; power, $26,978.76; street lighting, $32,637.73; ornamental lighting, $10,561.84. The expenditures totalled $142,283.54; leaving a gross surplus of $49,365.10, of which $24,000 was written off for depreciation, admitting a net surplus of $25,365.10.

Edmonton, Alta.—The extension of the P.G.E. railway into the Peace River district of Alberta, a line which, it is stated, will be a subsidiary road of the G.T.P. system, will start from the confluence of the Fraser and Salmon Rivers, following the latter to Summit Lake, thence along the Crooked River to Fort McLeod and McLeod Lake, thence along the Missinchinka River, through Pine Pass and along the Pine River to Hudson's Hope, following the peace River to the Alberta boundary, connecting with the McArthur railway.

St. John, N.B.—A conference was held recently at St John between the city commissioners and the members of the board of trade with reference to the Valley Railway extension and bridges. The outcome was the general endorsation of a suggestion that the road be allowed to end at the point it has reached,—e.g., Gagetown—unless it can be finished to St. John, as originally planned. The board of trade will, however, continue to deal with the matter and will probably send a delegation to Ottawa to urge further federal aid for the bridges which would have to be constructed on the extension to St. John as originally planned.

Vancouver, B.C.—Mr. J. W. Stewart, president of the P.G.E. railway, has announced that employment will be given to 12,000 men this year on construction work. Three important contracts have been let covering the proposed Kelly Lake-Fort George line, which is some 280 miles in extent. Only 100 miles, however, are included in the contracts issued. As the contractors have just finished work on the G.T.P. railway at Fort George, the new work will begin at once, and it is expected that this entire section will be completed next year. The contract for the first 100 miles of the extension north of Fort George into the Peace River country will be let by the end of next month.

Toronto, Ont.—The following is part of a resolution which was carried unanimously on March 25th in the Ontario legislature: "In the opinion of this House, cheap and convenient electric railway transportation facilities is one of the most urgent needs in many rural sections and towns of the province, and this House would respectfully urge upon the Dominion government the importance of the question and the wisdom of encouraging the construction of municipal Hydro-Electric radial railways, and that this House further respectfully urge upon the Dominion government the great importance of co-operating with the province in the development of the water powers created by existing and projected canals now under construction and capable of development by the utilization of the waters necessarily supplied thereto and not required for navigation purposes."

Quebec, Que.—The Dorchester Electric Company, of Quebec, which has been in operation only about fourteen months, has completed its first year with a satisfactory surplus of $4,000; and the earnings for the first months of 1914 showed a rate much in advance of this, a surplus of $1,379 remaining after interest and other fixed charges were met. The company is extending its business substantially and is gradually cutting down operating expenses. The company's largest contracts are the lighting of the streets and municipal buildings of Quebec for a period of 10 years, a contract with the town of Montcalm for the same period, and a similar contract for Charlesbourg for the same period. The peak load which the company can carry is 1,640 h.p. At present customers are taking about 1,500 h.p. for lighting purposes; and the motor load is only 827 h.p.

Taghum, B.C.—The contractors for the Taghum bridge, Hodgson, King and McPhalen Bros., of Vancouver, are confident that the structure will be ready for traffic by May 1st. Work on the three main spans is being rushed to completion; and in addition to these, which are of truss design, there are two short spans to be placed in connection with the approach to the bridge from the south side. These, however, can be placed, no matter what the condition of the water may be. At present the contractors are exerting all their energies on the three main spans, so that these may be completed before any material rise in the water takes place. Costing in the neighborhood of $100,000, the bridge, which will be finished well within contract time, is almost entirely a product of British Columbia. Cement manufactured at Princeton, steel fabricated at Vancouver, and lumber grown in this province, are the materials which have been used.

NEWS OF THE ENGINEERING SOCIETIES

Brief items relating to the activities of associations for men in engineering and closely allied practice. THE CANADIAN ENGINEER publishes, on page 90, a directory of such societies and their chief officials.

CANADIAN SOCIETY OF CIVIL ENGINEERS, OTTAWA BRANCH.

The last evening meeting for the season of the Ottawa Society of Civil Engineers was held on April 2nd, when Walter J. Francis, C.E., Consulting Engineer, of Montreal, delivered an address, entitled "The Engineer and the Public." The meeting was held in the Board Room of the Commission of Conservation, and was attended by 75 members. Mr. Francis advanced many arguments in favor of a united effort on the part of engineers to elevate the profession, claiming the best ways for accomplishing it to be a better education of the young man entering it, the maintenance of a proper standard of dignity, and perfection in the work of the engineer, and co-operation with fellow-engineers.

The address was followed by an excellent discussion, Messrs. R. F. Uniacke, C.E., C. R. Coutlee, C.E., Noulan Cauchon and others taking part. Mr. Geo. A. Mountain was chairman.

NOVA SCOTIA MINING SOCIETY.

The annual meeting of the Nova Scotia Mining Society will be held in Sydney, N.S. on April 14th and 15th. Indications are that it will be the most successful gathering in the history of the society. Addresses and technical papers have been prepared which will be read by a representative list of men in mining in the Maritime Provinces, and the programme gives evidence of a comprehensive review of the entire mining industry as applied to Eastern Canada. The principle topics under discussion will be electricity in mining and coal. The following is a list of some of the speakers together with the subjects which they will present:—

"Distillation of coal"—F. E. Lucas.

"Fletcher's unfinished work"—W. N. McDonald.

"Longwall machine mining"—J. F. K. Brown.

"Longwall development at Jubilee Colliery, Sydney Mines"—Robert Robinson.

"Electric motors for various services in the mining industry"—C. H. Wright, Halifax.

"Cinematographics and science"—Alexander Theuerkauf.

"A mining engineer of the fifteenth century. De Re Metallica Georgius Agricola, 1545"—F. W. Gray.

"Mine fatalities"—Robert Drumond, Stellarton.

"Use of typographical survey maps in mining"—R. Boyd.

"Shipping piers"—D. H. McDougall.

"Methods of mining two coal seams lying near together"—W. Herd.

"Coal as seen under a microscope"—A. J. Tonge.

It is expected that R. W. Brock, Deputy Minister of Mines, Ottawa, will be present and will deliver an address.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.

The 7th annual assembly of the Royal Architectural Institute of Canada will be held at Quebec, Que., on September 21st and 22nd, 1914. A very interesting programme is being prepared, which will include matters of interest to every Architect in the Dominion. The programme will be sent early in August to all the members of the R.A.I.C., and will contain all the particulars. The committee of arrangements of the Assembly is composed as follows: J. H. G. Russell, Jos. P. Ouellet, René P. LeMay, Albert R. Décary, and Alcide Chaussé, Hon. Secretary.

DINNER TO DEAN GALBRAITH.

The graduates of the Faculty of Applied Science and Engineering, University of Toronto, who are resident in Ottawa, held a dinner on March 28th, in honor of Dr. John Galbraith, Dean of that Faculty. The banquet, held at the Chateau Laurier, was attended by over 80 graduates. The function was most successful and great credit is due to the organizers. It is the first dinner of this kind that the graduates in engineering of the University of Toronto, who live in Ottawa, have held.

Prominent among the representatives from other centres were Major C. H. Mitchell, Consulting Engineer, Toronto, and a member of the Board of Governors of the University of Toronto; Professors C. H. C. Wright and T. R. Loudon, representing the Faculty of Applied Science and Engineering; Mr. J. L. Morris, Civil Engineer and Surveyor Pembroke, the earliest graduate of the institution; J. M. R. Fairburn, Assistant Chief Engineer of the Canadian Pacific Railway, Montreal; Walter J. Francis, Consulting Engineer, Montreal; G. H. Duggan, Vice-President of the Dominion Bridge Company, and others.

An important outcome of the gathering was the appointment of a local committee, consisting of Messrs. T. Shanks, J. B. Challies, R. S. Smart, F. D. Henderson, F. D. Withrow, P. F. Morley, G. H. Ferguson, J. L. Stacey and W. F. M. Bryce, to arrange for a permanent organization to take the form of Ottawa branch of the Engineering Alumni Association of the University of Toronto, and to be similar to the branches existing in various parts of Canada and the United States.

COMING MEETINGS.

AMERICAN WATERWORKS ASSOCIATION.—Thirty-fourth Annual Meeting to be held in Philadelphia, Pa., May 11-15, 1914. Secretary, J. M. Diven, 47 State Street, Troy, N.Y.

AMERICAN HIGHWAYS ASSOCIATION.—Fourth American Road Congress to be held in Atlanta, Ga., November 9-13, 1914. J. E. Pennybacker, Secretary, Colorado Building, Washington, D.C.

AMERICAN PEAT SOCIETY.—Eighth Annual Meeting will be held in Duluth, Minn., on August 20, 21 and 22, 1914. Secretary-Treasurer, Julius Bordollo, 17 Battery Place, New York, N.Y.

AMERICAN SOCIETY FOR TESTING MATERIALS—Seventeenth Annual Meeting to be held in Atlantic City, N.J., June 30 to July 4, 1914. Edgar Marburg, Secretary-Treasurer, University of Pennsylvania, Philadelphia, Pa.

CANADIAN AND INTERNATIONAL GOOD ROADS CONGRESS.—To be held in Montreal, May 18th to 23rd, 1914. Mr. G. A. McNamee, 909 New Birks Building, Montreal, General Secretary.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Seventh Annual Meeting to be held at Quebec, September 21st and 22nd, 1914. Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal.

MANITOBA ENGINEERING SOCIETY.

The Engineering Society of the University of Manitoba has recently issued the 1914 number of its official publication, "The Manitoba Engineer."

ARCHITECTURAL CLUB, UNIVERSITY OF TORONTO.

Plans for a power-house contemplated by the Water Power Branch, Department of the Interior, for the generation of electrical energy at Cascade River, near Banff, Alta., were drawn in competition in the Department of Architecture, University of Toronto. Of the resulting designs Mr. A. C. Wilson, a 4th year student, submitted the first prize winner. Mr. Merrill Denison of the 3rd year and Mr. Lester Husband of the 2nd year received the 2nd and 3rd prizes, respectively.

PERSONALS.

J. W. BATTERSHILL, at present in the City Engineer's office, Winnipeg, has just been appointed Engineer to the Municipality of East Kildonan.

R. A. BARRETT, Superintendent of the Toronto, Hamilton and Buffalo Railway, has just resigned owing to ill-health and has been succeeded by H. T. Malcolmson.

WALTER J. FRANCIS, C.E., consulting engineer, of Montreal, is at present on a trip to investigate sewerage and water supply problems in several cities of Western Canada.

H. T. ROUTLY, B.A.Sc., of Routly and Summers, left last week for Huntingdon, P.Q., to get his road machinery and equipment into shape for several large contracts which he has in hand there for this season.

WALLACE BROAD recently addressed the Engineering Society of the University of New Brunswick on "Engineering in China." Mr. Broad, an old graduate of that university, has spent considerable time in the Orient, and was for a lengthy period mining adviser to the Chinese Government.

ARTHUR L. MUDGE AND A. LEO MIEVILLE have become associated with Kerry and Chace, Limited, consulting engineers, Toronto, as managers of the electrical and mechanical branches, respectively. Mr. Mudge for over four years was chief electrical engineer for the Toronto office of Smith, Kerry and Chace, during which period they had charge of the design and construction of a large number of hydro-electric plants and long distance transmissions. For the past year Mr. Mudge has been chief engineer of the Midland Construction Company, which carried out most of the construction work for the Electric Power Company. He is first Vice-President of the Canadian Electrical Association and is on the library committee of the Toronto branch of the Canadian Society of Civil Engineers.

Mr. Miéville was at one time designer of high-speed machinery for W. H. Allenson and Company, Bedford, England, a firm for whom he acted until recently as engineer in Canada. Previous to this, Mr. Miéville had been assistant engineer upon the construction of the Winnipeg hydro-electric development, and turbine designer with the I. P. Morris Company, Philadelphia. Before leaving England, Mr. Miéville was for several years engaged upon paper mill engineering, and latterly in marine work, designing engines, turbines and general machinery for British and foreign admiralties.

OBITUARY.

CHARLES L. SMITH, General Manager of the Oregon Short Line Railroad, died last week at St. Catharines, Ont.

IRON AND STEEL OUTLOOK IN THE UNITED STATES.

The outlook for the iron and steel business in the United States is somewhat mixed. Orders on the books of the various mills at the beginning of April show a falling off as compared with the beginning of March, and a slowing down of operations is observed. This is more especially the case among the smaller than the larger producers. For prompt delivery, prices of the heavier lines, such as shapes, plates and bars, for second quarter contracts, are quoted at $1.25 Pittsburg, as against $1.20 for the first quarter, the efforts on the part of the mills to advance the price of the former $1 over the latter having failed. However, there has been a little more activity in the Eastern States for iron. No. 2 Birmingham iron has gone off 25 cents a ton, wire rods 50 cents and steel bars $1, as compared with the prices a week ago. On the other hand, a report comes from Pittsburg that the prices of billets and steel bars have been advanced $1 a ton to $22 and $23, respectively, at the mill, sales at these prices having taken place. In the East the market for finished steel is practically at a standstill, while a marked slowing up is observed in the Western markets for sheet and cast-iron pipe. While prices are keeping up well, the spring demand for wire products is expected to be below normal.

HOOK FOR MEASURING TAPES.

This hook, when attached to the first end of a steel measuring tape enables one person to take long as well as short measurements readily, while ordinarily two people are required; one at each end of the tape. It is a new article just put out by the Lufkin Rule Co. of Canada, Limited. It is a substantial, nickel plated hook with serrated face, and is designed so that it can be instantly attached to the first end of ¾ in. or ⅜ in. wide steel tapes. The hook grips the end of the article to be measured, and is so constructed that when attached to the first end of any regular tape measuring from the end of the ring, the zero point falls exactly at the inside of the hook so that measurements obtained are accurate. The hook can be as readily detached from as attached to tapes, in no way interfering with the use of the tape in the regular manner.

Vitrified Clays, Limited, announce the removal of their Calgary offices from the P. Burns Building to 236 Laugheed Building.

The offices of the Toronto Harbor Commission have been moved from the Bell Telephone Building to a more spacious location in the Otis-Fensom Building, 50 Bay Street, Toronto.

The city of Vancouver laid the following lengths in miles of pavements during 1913, according to the recent report of Mr. F. L. Fellowes, Supervising City Engineer:—Asphaltic concrete, 1.161; bitulithic, .248; granitoid, .179; brick block, .124; concrete, .026; wood block, .462; total, 2.200 miles.

The record of the Department of Labor for February shows that there was a pronounced decrease in the number of days lost through strikes and lockouts, as compared with the previous month, although the number was somewhat larger than for the corresponding month of last year. The decrease was largely due to a settlement of a strike of shoe machine workers in Quebec, about 3,000 employees returning to work on February 14. There were altogether seven disputes in existence in Canada during February, as against five in January and nine in February of last year. About 23 firms and 4,400 employees were involved in these disputes. Approximately 66,937 working days were lost as compared with 117,450 during January, and 42,880 during February of last year. Three disputes commenced during February, none of which were serious from the standpoint of numbers affected. They were all, moreover, of short duration. The dispute of coal miners on Vancouver Island and garment workers at Montreal remained unsettled at the end of February.

ORDERS OF THE RAILWAY COMMISSIONERS
OF CANADA

Each week on this page may be found summaries of orders passed by the Board of Railway Commissioners, to date. This will facilitate ready reference and easy filing. Copies of these orders may be secured from *The Canadian Engineer* for small fee.

21534—March 24—Amending Order No. 21382, dated December 12th, 1913, by striking out words and figures, "Between Southeast Quarter of Sec. 9, and Northeast Quarter of Sec. 16," in description of crossing No. 8 in operative part of Order, and substituting therefor words and figures, "Between the S.E. ¼ of Sec. 16 and the N.E. ¼ of Sec. 9."

21535—March 24—Authorizing C.P.R. to connect with its main line, Lake Superior Div., Cartier Subdivision, the spur of Mond Nickel Co., Limited, at mileage 103.25 of main line, in Lot 8, Con. 5, Tp. Dowling, Dist. Sudbury, Ontario.

21536—March 24—Authorizing G.T.R. to operate trains across fifty-seven (57) bridges.

21537—March 23—Authorizing G.T.R. to construct two (2) bridges—namely, No. 29, mileage 83.50 19th Dist., over Grand River, nearest station, Paris; and No. 21, mileage 76.02, 19th Dist., over Brantford and Tilsonburg tracks, nearest station, Brantford, all in Province of Ontario.

21538—March 24—Authorizing G.T.R. to construct bridge No. 257, at mileage 25.25, 13th Dist., in town of Milton, Ont.

21539—March 23—Authorizing G.T.R. to construct five (5) bridges, on its 12th District, Province of Ontario.

21540—March 23—Authorizing G.T.R. to construct siding into premises of Pelleyrino Del Sole, on Lot 105, parish of St. Bruno, Co. Chambly, Que.

21541—March 25—Suspending, tariffs and supplements applicable to international traffic, filed by G.T.R., M.C.R.R., Wabash, R.R., C.P.R. and P.M.R.R., pending hearing, to be fixed by Board, at which said Cos., will be required to justify said removal of Essex Terminal Ry. from joint tariffs, at present in effect.

21542—March 4—Authorizing Cedars Rapids Mfg. and Power Co., of Montreal, to take additional width of 25 ft. for its right of way for its transmission line, making in all a width of 125 ft. across certain lots known as Lots 262, 266, 267, 268 and 269, parish of St. Ignace du Coteau du Lac, property of Idala Charlebois; and Lot 183, parish of St. Polycarpe, Co. Soulanges, property of Charles Houle.

21543—March 19—Authorizing G.T.R. to expropriate lands between Yonge and Cherry Sts., Toronto, Ontario.

21544—March 24—Approving and authorizing clearance at G.T.R turntable at St. Thomas, Ont.

21545—March 24—Authorizing G.T.R. to reconstruct Bridge No. 328, carrying its railway across Vanstone's Pond at mileage 143.14, 6th Dist., near Lansdowne, Ontario.

21546—March 23—Approving revised location of G.T.P. Branch Lines Co.'s Regina-Moose Jaw Branch through north half of Sec. 28-17-20, W. 2 M., mileage 2.10 to 3.11, Dist. Regina, Sask.

21547—March 25—Authorizing G.T.R. to operate trains over interlocking plant at Paris Jct., Ont., without their first being brought to a stop.

21548—March 23—Approving location C.P.R. station at Denhart, on its Bassano Easterly Branch Line, in N.E. ¼, Sec. 2-20-11, W. 4 M., Alberta.

21549—March 24—Directing that G.T.R. submit for approval of Board a plan showing location of new station at Summerstown Station, Ont.; that Co. provide adequate and suitable accommodation for receiving, loading, unloading and delivering of all traffic offered for carriage upon its Rly., at Summerstown; erection of station be completed and facilities be provided by July 1st, 1914.

21550—March 24—Authorizing city of Fort William to construct, at its own expense, highway crossing over G.T.P. Ry., where Stanley Ave. would intersect said railway, Fort William, Ont.

21551—March 24—Directing C.P.R. to reappoint station agent at Beverly Station, Sask.

21552—March 25—Authorizing Board of Highway Commissioners for Government of Sask., at its own expense, to construct highway crossing over C.N.R. in N.W. ¼, Sec. 31-26-13, W. 3 M., at west end of station grounds at Forgan, Sask.

21553—March 21—Amending Order No. 21332, dated February 4, 1914, by exempting from operation of the Order the land of H. Strong, Tp. Bathurst, Co. Lanark, Ont., subject to certain conditions, that Rly. Co. (C.P.R.) erect return fences and cattle guards on H. Strong's farm crossing.

21554—March 24—Authorizing C.P.R. to construct spur for city of Moose Jaw, Sask., on Subdivision Lots 27, 28, 29 and 30, Block 127, city of Moose Jaw, Sask.

21555—March 26—Authorizing the Cedars Rapids Manufacturing and Power Co. of Montreal to take additional land for its right of way for its transmission line across certain lots in the parish of St. Joseph de Soulanges, Co. Soulanges, Province of Quebec.

21556—March 24—Authorizing the C.P.R. to construct road diversion in Sec. 34, Twp. 20, Rge. 7, W. 2 M., Sask., at mileage 100.3, McAuley Subdivision of its line of railway.

21557—March 25—Authorizing the Niagara, St. Catharines and Toronto Ry. to construct, maintain and operate a siding for the Electric Steel and Metals Co., Limited, in the town of Welland, Ont., and to construct said spur along Lincoln Street and across Denistoun Street.

21558—March 26—Authorizing the Toronto, Hamilton and Buffalo Ry. to construct, maintain and operate a temporary branch line of railway, or spur, on Lot 2, in the Broken Front Concession of the said Twp. of Barton, extending from a point marked "O-H.B." on the T.H. and B. branch line of railway serving the National Steel Car Co., Limited, and running thence northeasterly through the lands of the said National Steel Car Co., into and across the lands of Sir H. M. Pellatt, to and into the lands of the Dominion Power and Transmission Co., to a point marked "9-50 end track;" said branch line to be constructed and completed within six months from date of this Order.

21559—March 27—Extending the time within which the Campbellford, Lake Ontario and Western Ry. may use the crossing of the C.N.R. in the east half of Lot 12, Con. 4, Twp. Scarborough, Co. York, Ont., at mileage 0.35, until March 27th, 1915.

21560—March 26—Refusing application of the town of Forward for order directing C.P.R. to move its station; ordering C.P.R. to construct a spur at Forward, Sask.; commencing at a point on its Ry. just east of the distant semaphore and running eastwardly for a distance of five hundred feet; said spur to be constructed and completed by June 1st, 1914.

21561—March 31—Certifying that correction of book of reference endorsed on C.P.R. plan dated June 24th, 1911, to show Henry L. Auger as owner of portions of lands lying between stations 70-99 and 73-25 and between 73-91 and 75-16 respectively, instead of C.P.R. Co., is allowed.

21562—March 27—Authorizing C.P.R. to construct extension to spur for Hyde and Sons, Limited, in city of Outremont, Que.

21563—March 27—Authorizing G.T.R. to construct siding, subject to terms and conditions in by-law No. 74 with exception of condition No. 7, commencing at a point on 19th Dist., of its Rly. south of Allanburg Station, thence in a southwesterly direction upon, along and across Water Street (not opened), in village of Allanburg, Co. Thorold, Ontario.

21564—March 30—Authorizing Board Highway Commrs., for Government of Saskatchewan to construct, subject to terms of consent on behalf of C.N.R., at its own expense, highway over right of way and tracks of C.N.R. in N.E. ¼, Sec. 8-48-25, W. 3 M.