PAGES

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The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

Index to Volume 29, July to December, 1915

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The Canadian Engineer

A weekly paper for engineers and engineering-contractors

POWER DEVELOPMENT AT IROQUOIS FALLS, ONT.

ABITIBI POWER AND PAPER COMPANY'S PLANT ON THE ABITIBI RIVER — ONE OF CANADA'S LARGEST HYDRAULIC DEVELOPMENTS FOR DIRECT INDUSTRIAL CONSUMPTION.

THE Abitibi Power and Paper Company controls by provincial leases some 57,000 net horse-power of continuous water power on the Abitibi River, together with about 1,000,000 acres of pulpwood limits in the vicinity. In April, 1913, the construction was commenced at Iroquois Falls, about 35 miles by river from Lake Abitibi, and about 30 miles southeast of Cochrane, of a large development exclusively for the manufacture of pulp and paper. The plant is now practically completed and is in many respects one of the most unique of its kind. It is particularly well arranged and is equipped with most modern and complete pulp and paper-making machinery.

The Abitibi River affords ideal transportation facilities for logging operations. It has sufficient current of itself to drift the logs from the launching points up-stream to the booms. The wood-room is at the water's edge and is fed directly by means of a jack-ladder, as shown in several of the illustrations. For the finished product the Temiskaming & Northern Ontario Railway has a branch line seven miles in length, connecting with its main line at Porquis Junction, providing outlets to market via North Bay, and also via Cochrane, if desired.

The development consists essentially of a spillway dam in sections of concrete and earth embankment with a concrete core-wall and riprapped with rock; a power house equipped with ten turbines of the double-runner horizontal type discharging into single draft tubes and aggregating 17,000 h.p., direct connected to ten pulp-grinder units of two stones each; and three turbines aggregating 5,100 h.p., direct connected to electrical generators supplying power for machines such as barkers, presses, etc., in the pulp mills and for part of the paper-mill equipment as well; a ground-wood pulp-mill with a capacity of 200 tons of pulp per day, put into operation in July, 1914; a sulphite mill to be completed in July, and a paper mill with a battery of four machines capable of turning out 225 tons of news print daily. There are, in addition, extensive storages for wood, pulp and paper. The plants, comprising the different mills, are necessarily equipped with an elaborate and complex arrangement of fire pumps and piping, conveyers, shafting, etc., besides the chiefer machinery installations. This article will not deal, however, with the

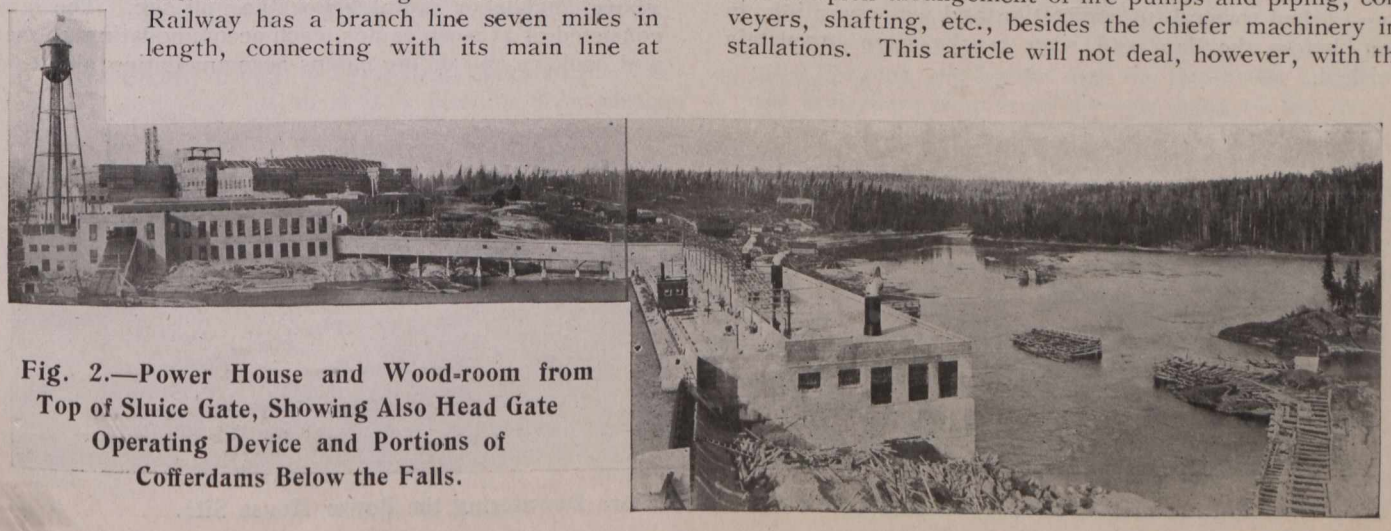


Fig. 2.—Power House and Wood-room from Top of Sluice Gate, Showing Also Head Gate Operating Device and Portions of Cofferdams Below the Falls.

distribution or consumption of power, but will confine itself to the important constructional features of the development. For a simplification of the routine of development, the following headings will be adhered to: Camp lay-out and transportation facilities; river works; rock excavation and concreting; dam and spillway; power house; mechanical pulp-mill; sulphite pulp-mill, and paper-mill. It is well to remember, however, that the construction of the power house and mechanical pulp-mill was pushed through to completion and was operating, in fact, before the dam and river works were completely finished.

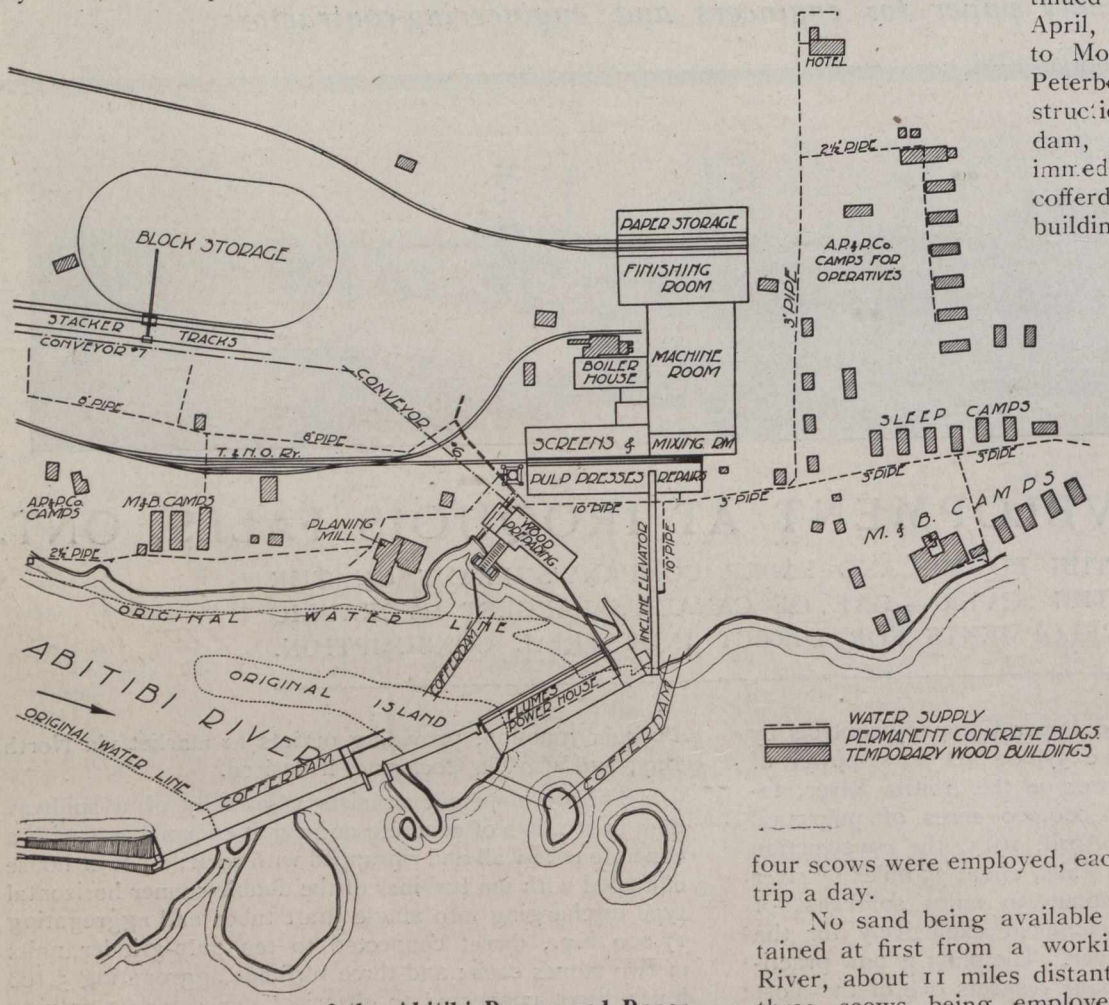


Fig. 3.—General Layout of the Abitibi Power and Paper Company's Development at Iroquois Falls, Ont., Showing also the Construction Camp Arrangement and the Location of Cofferdams for the Construction of the Power House and Dam.

Camp Layout and Transportation Facilities.—Before the commencement of operations the river banks at the site of the plant were heavily timbered and in December, 1912, the work of clearing a railway right-of-way and the mill site on the west side of the river was begun and continued during the winter. In April, 1913, the contract was let to Morrow & Beatty, Limited, Peterborough, Ont., for the construction of the pulp mill and dam, and operations were immediately commenced on the cofferdam on the west bank. The building of camps and storehouses for over 400 men and supplies was also started in April.

The work of transportation was one of the greatest difficulties with which to contend at that time. Shortly after the contract was let, the winter road was destroyed and all supplies had to be brought in by water route from a point where the T. & N.O. crosses the Black River at Matheson, a distance of 22 miles. Practically all the plant and supplies were transported in this way from Matheson. Two gasoline launches and four scows were employed, each launch making one round trip a day.

No sand being available in the vicinity, it was obtained at first from a working developed on the Black River, about 11 miles distant, and brought in by scow, three scows being employed, each with an average capacity of about 40 cu. yds. From the middle of June until September their constant operation transported to the site about 9,000 cu. yds. In August the Iroquois Falls branch of the T. & N. O. was put into operation and largely solved the transportation problem. Later in the year sand was obtained from a pit on the T. & N. O. about 15 miles distant.

Ground conditions affected to a considerable extent the lay-out of the camp. Staff camps were constructed above, and labor camps below the mill site. The latter consisted of 11 sleep camps, each accommodating 40 men, and cookery and dining camps accommodating about 600

Fig. 4.—Cofferdams Above and Below the Falls Before Dewatering the Power House Site.

men. The general arrangement is illustrated in the accompanying drawing.

River Works.—The river had a total width of about 1,000 ft. along the crest of the fall, intercepted, however, by three islands, as shown. The cofferdam work was started from the west bank to cut off the west channel of the river, upon which the proposed site of the power house was situated. Initial operations were delayed owing to an unprecedented rise of the river, which carried away the first cofferdam while under construction. When the abnormal flow had subsided, another cofferdam was built immediately above the site of the old, in water that had a maximum depth of 26 ft., and on a gravelly clay bottom. These cofferdams were of ordinary timber-crib construction aggregating 180 ft. in length. They were rock-filled and sheeted on the face with two thicknesses of 2-inch plank, driven by light, hand-operated pile hammers to an average depth of 3 ft. into the river bottom. The sheeting was placed and nailed under water by a diver. The cofferdam was filled along its face with clay excavation from the site of the wood-preparing room. On the west shore of the river and for a length of about 100 ft. a heavy deposit of silt gave some difficulty and necessitated the use of a different method. Wakefield piles were driven by steam hammer to a maximum depth of 25 ft. in this portion.

Before the upper cofferdam on the west side was completed the lower one was started, consisting of two sections; the first, 430 ft. long, to a small island below the falls, and the second, 200 ft. long, from this to the main island east of the west channel. Their locations are shown in Fig. 3. They were also built of timber cribs with a maximum depth of 20 ft., sheeted and banked with clay.

All the leakage from the lower cofferdam was conducted to a sump near the centre and removed by two 12-inch centrifugal pumps. The leakage from the upper one was conveyed to a sump below the original fall and pumped by a 6-inch centrifugal pump to the sump for the 15-inch pumps. After dewatering, a single 12-inch pump, working about one-third the time, handled the leakage.

These cofferdams for the power house were completed in 1913. Immediately after high water in the spring of 1914, the construction commenced of the cofferdam for the dam. It extended from the main island to the west shore above the falls. It was also built in two sections, the first 200 ft. in length and extending from the island to a point beyond the east pier of the Stoney sluice. The section of dam across the island and the Stoney sluice itself were then installed and by the time the latter was in operation the cofferdam from it to the east bank of the river had been completed. This one was built sufficiently high to permit of the operation of the plant.

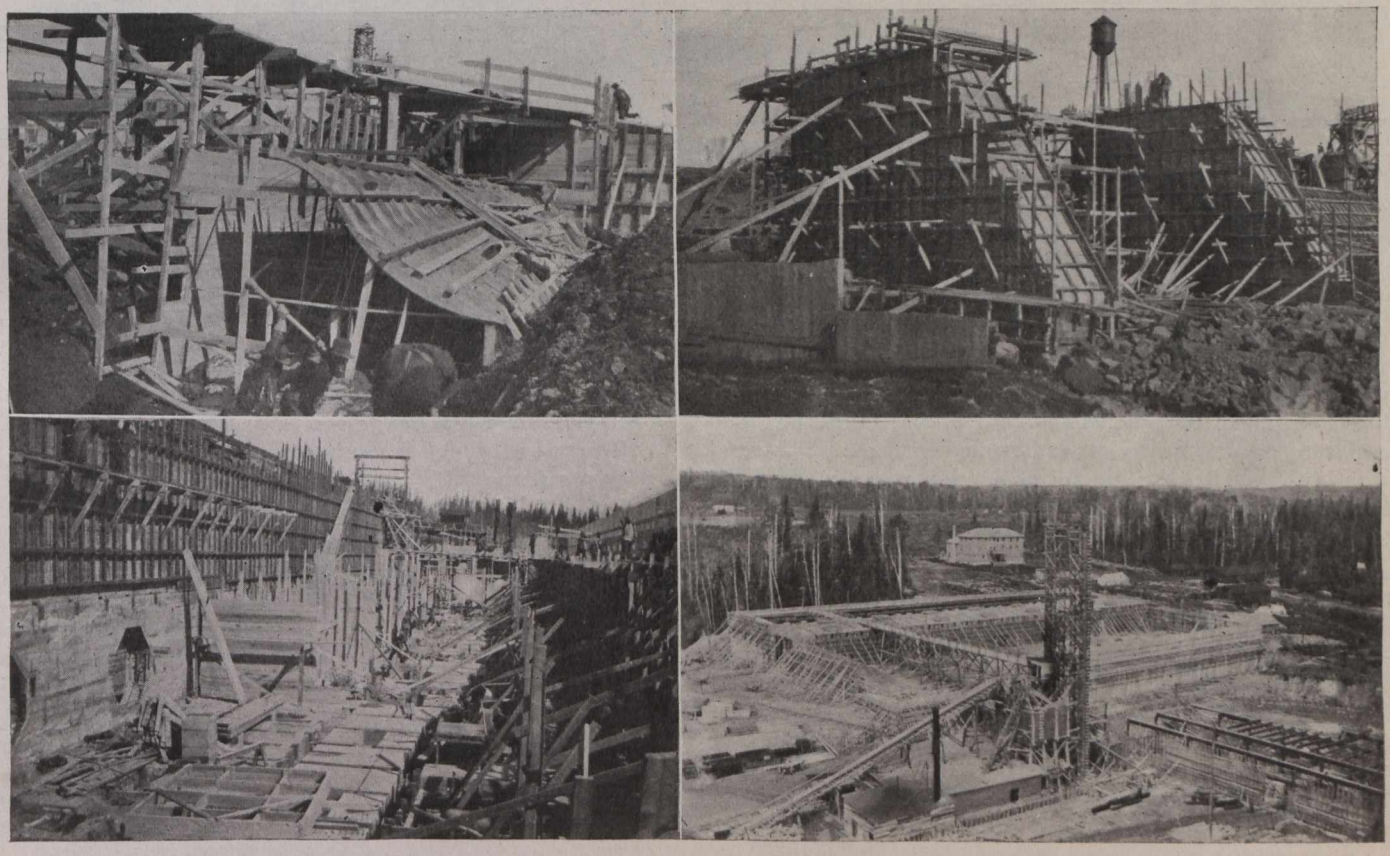


Fig. 5.—Formwork Typical of Dam, Power House and Mill Construction.
Power House End of Dam. Stoney Sluice.
Breast Wall and Floor of Power House. Storage and Finishing Rooms.

It is interesting to note that during 1914 little difficulty was experienced in the way of high-water troubles in cofferdamming operations in the east or main channel of the river. This was owing to the completion at Couchiching Falls of a timber crib storage dam constructed by the company as a part of the Abitibi development to regulate the flow at Iroquois Falls. This dam was in operation during the summer and shut off the discharge from Lake Abitibi.

Rock Excavation and Concreting Plant.—The power house flumes are built entirely on rock and required the removal of 16,600 cu. yds. of rock excavation for the draft

tubes and flumes, and in clearing a sufficient depth in front of the racks. The work was commenced immediately upon the completion of the first up-stream cofferdam and was completed to proper grades in October, 1913.

The rock was handled by three main derricks capable of reaching every part of the excavation. From them it was deposited by another derrick on the crushing plant platform on the bank above. The plant consisted of two No. 2½ Climax steam-driven jaw crushers. From these the rock was elevated directly to the bins, above which it was screened into inch and 2½-inch sizes. The bins, which were capable of holding 50 cu. yds. of 1-inch and

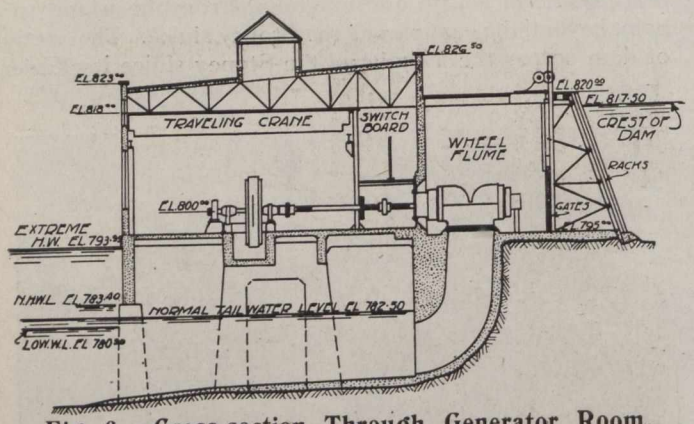


Fig. 6.—Cross-section Through Generator Room.

120 cu. yds. of 2½-inch stone respectively, were supported on posts set on sills. They were 22 ft. x 12 ft. high and the siding consisted of 2 x 8's, laid flat. The adjoining sand bin was of similar construction. The sand was conveyed to the bin by an incline railway from the sand dump on the west bank immediately above the cofferdam.

The bins were set sufficiently high to allow the operation directly under them of two No. 2½ Smith mixers. These dumped directly into side-chute concrete cars of ¾-yard capacity, run on trestles to the power house forms, and, by means of an incline railway, up the hill to the wood-preparing and screen rooms of the mill, then under simultaneous construction. In the early stages of construction the cement was conveyed by the sand railway to the top of the bins and delivered thence by chute to the working platform of the mixing plant. Later, an industrial track brought it from the railway siding to the top of the hill above the plant and it was delivered, as in the former instance, by chute.

Dam and Spillway.—The dam, which is of gravity type of plain concrete, was constructed in 50-ft. sections with expansion joints between the sections. It runs in a straight line from the generator room and is in two sections, the first being 221 ft. long and extending to the western 8-ft. solid pier of the Stoney sluice. The second section extends from the sluice to the east bank of the river, a distance of 450 ft. Here it is met by an earth embankment 443 ft. in length. The latter has a core wall for its entire length, the maximum section of the

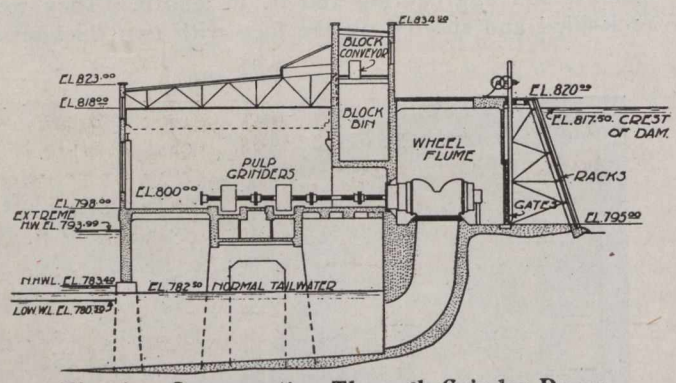


Fig. 8.—Cross-section Through Grinder Room.

wall being 12 ft. high and 24 ins. wide at the top, tapering to 36 ins. at the base. The earth embankment is 12 ft. in width at the top with a 2:1 slope on the up-stream side, which is riprapped, and a 1½:1 slope on the down-stream side. The maximum height of the dam is just east of the Stoney sluice, where it attains 32 ft.

The dam was commenced in April, 1913, and completed in August of the same year; 7,492 cu. yds. of concrete and 6,040 cu. yds. of earth were used. The concrete was placed from a plant established at the south of the generator room of the power house. To it stone and sand were transported by a trestle which crossed just below the upper cofferdam. The concrete was hoisted by a 90-ft. tower and delivered by chute into a hopper 200 ft. distant, from which it was deposited along the dam by Ransome concrete carts. The Stoney sluice was supplied and erected by the Dominion Bridge Co.

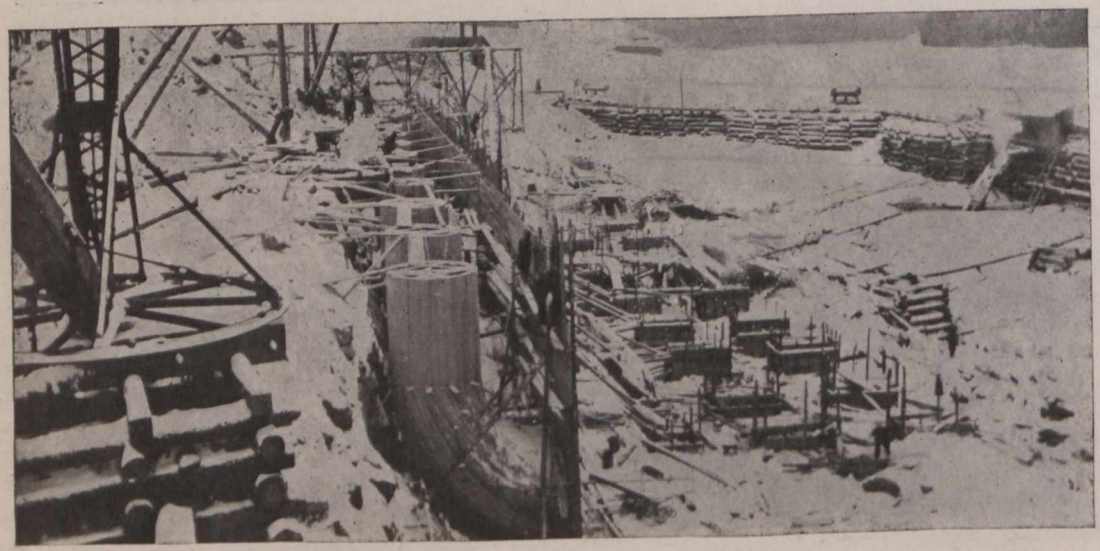


Fig. 7.—Power House Construction, Showing Draft Tube and Pier Forms and Cofferdam, Looking North.

Power House—This structure, which includes the pump room at the north side, is 361 ft. long and 52 ft. 6 in. wide. The pump room rests entirely on rock, the flumes and breast wall of all the units are also on rock foundation, while the grinder room and generator room are supported on three rows of battered piers, most of which are set upon reinforced concrete footings resting on the boulders below the original falls, where rock foundation is not accessible. A rock-

fill timber crib protects the boulder bottom between these piers from any erosion that might be caused by water discharged from the draft tubes. The piers were commenced in November, 1913, and brought up to floor level before severe weather set in, whereupon they were left until the following spring for completion. Mass concreting for the draft tubes and flume bottoms also began in November, and was continued without interruption until completion in February, 7,050 cu. yds. of concrete being placed. For this work, under severe weather conditions, the sand was steam-heated by perforated pipes in the bottom of the bin and with the use of heated water made a normal and very satisfactory mix. After placing, the concrete was protected by tarpaulin coverings and by steam hose laid under the tarpaulins. Part of the work was done in exceptionally cold weather, but the method used gave every satisfaction.

Immediately upon the completion of the concrete work in the flume bottoms, the walls forms for the flumes and breast wall were placed. These walls are 25 ft. high and 2 ft. thick. In them the main reinforcing is horizontal and consists of 1-in. round rods at 3-in. to 6-in. centres. In February, 1914, the reinforcing was placed, the rack structure built up with a temporary wooden housing over it and the flumes roofed over. Stoves were installed in each flume. Pouring of concrete began in March and was completed early in April. When the flume walls were finished, the grinder and generator room walls were proceeded with. The general design is shown in the cross-sections illustrated herewith. Briefly, it is a reinforced concrete girder construction, the girders being 2 ft. thick and running lengthwise between piers carrying the superstructure walls and machine foundations. The columns are placed at 18-ft. centres crosswise of the building and at 21-ft. centres lengthwise. The pipe galleries which are also of reinforced concrete are suspended between the girders. In passing, it may be observed that the superstructure walls of all the buildings are of plain concrete.

The machinery was installed while the superstructure of the power house was under way, and the plant was almost ready for operation upon the completion of the building, which was in July, 1914. The water-wheels were put in by Holyoke Machine Company; the grinders were supplied by the Waterous Engine Works, Brantford, and installed by the Abitibi Power and Paper Co. They are direct connected to the wheels, two on each shaft. The generators are of Westinghouse make and direct connected. They are 1,250 kw., 600-volt a.c., 60 cycles, 3-phase with direct-connected exciters. Lombard governors are used on the wheels driving the generators, while the grinder turbines are hand-regulated.

The electrical power developed is used for driving the pumps, barkers, wet machines, presses, conveyers, etc., throughout the mills, besides lighting.

The flume gates are of 8 x 12-inch yellow pine, and are 9½ ft. x 12 ft. each with both motor and hand-

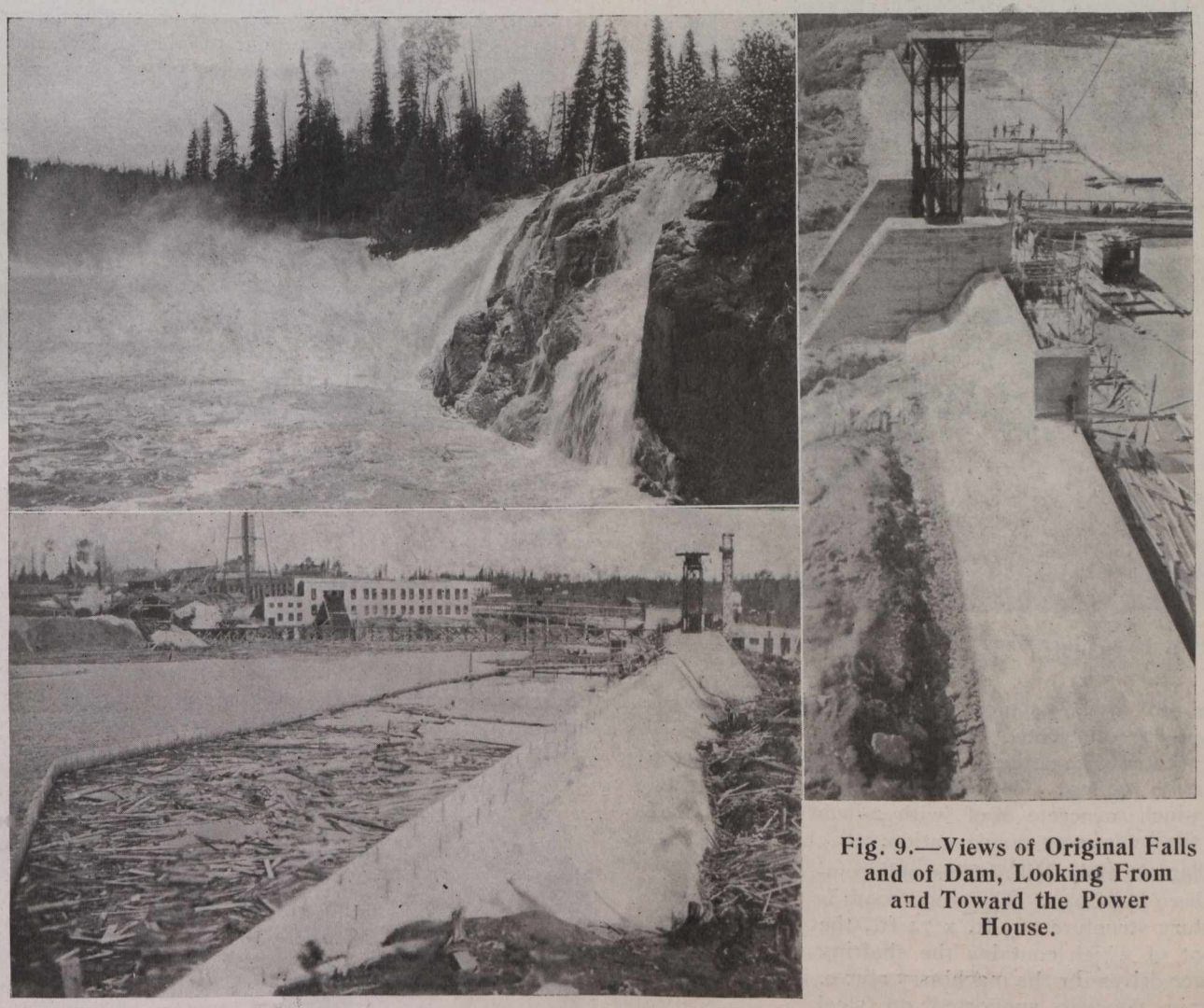


Fig. 9.—Views of Original Falls and of Dam, Looking From and Toward the Power House.

operating devices. There are two gates for each flume. A travelling hoist operates on tracks laid on the flume deck above.

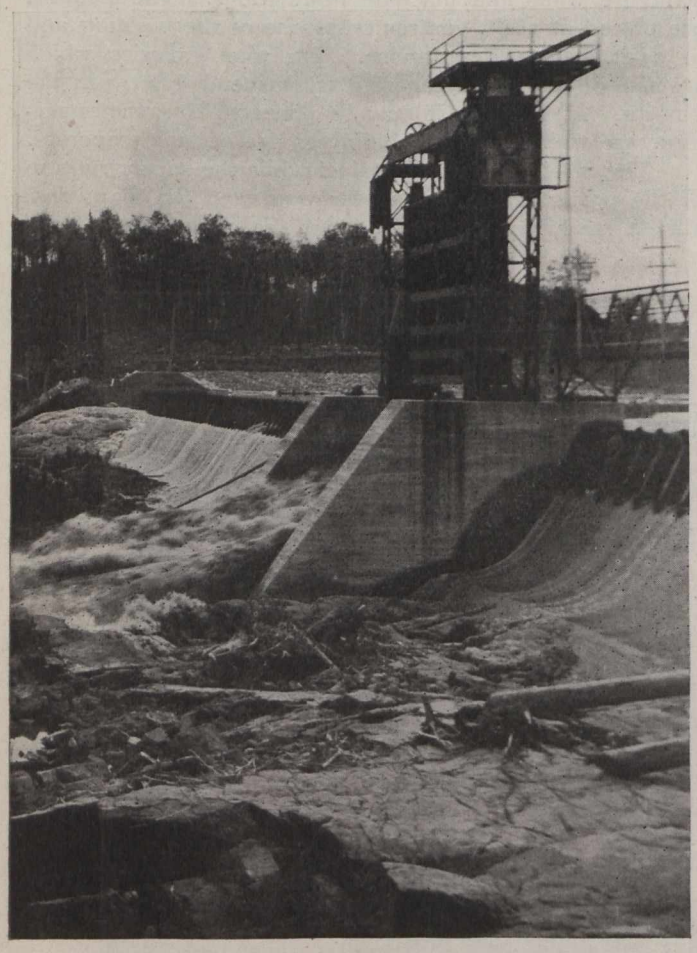


Fig. 10.—Close View of Open Sluice Gate.

The roof of the grinder room, like those of the other buildings, is constructed of 3-inch and 4-inch matched spruce, treated with carbolineum and covered with Barrett specification roofing. The generator room has a 3-inch concrete roof with 2-inch hollow tile to prevent condensation.

Mechanical Pulp Mill.—This mill comprises three buildings. The wood room is a two-story structure 163 ft. x 74 ft., the basement of which contains the shafting and motor drives for the machinery above. The main floor is supported on steel columns and beams. It carries the slashers, barkers, etc. Like the other buildings, its walls are of plain concrete. Being built on a side hill, excavation to the extent of about 7,000 cu. yds. was required.

South of the wood room is a building originally intended for a boiler house. When the company decided upon the erection of a sulphite mill and a paper mill, it was converted into a fire pump room and filter house. It is a single-story structure 53 ft. x 35 ft.

From the north end of the pump room adjoining the power house an incline elevator building 15 ft. x 362 ft. and built of concrete, leads to the screen room on the top of the river bank. This screen room is 254 ft. x 139 ft. and the adjoining repair shop is 108 ft. x 76 ft. Work on the building was started in May, 1913; about 20,000 yards of excavation were removed by half-yard wheel scrapers and the balance, 6,526, by carts. The concrete for these buildings was mixed in the main plant near the power house and brought up the hill in cars on a truck operated by a hoist at the head of an incline railway.

Sulphite and Paper Mills.—The contract for the construction of the sulphite mill and also of the paper mill was let in 1914. Excavation for the former amounted to about 58,000 cu. yds. of clay, which was removed by steam shovel, and deposited for railway embankment. Gravel for concreting work was brought in on the T. & N. O. from a deposit about 15 miles distant, unloaded into a bin from which it was elevated in a 1 cu. yd. car on an inclined railway to bins of similar construction to those used for the pulp mill concreting. These fed directly to the mixers below, from which the concrete was hoisted to hoppers at different elevations on towers set immediately in front of the mixers. It was distributed from these hoppers partly by chute and partly by Ransome carts and deposited in the walls.

These buildings have a total floor area of 166,000 sq. ft., and are partly single story, the paper-machine room and the mixing rooms 317 ft. 6 in. x 182 ft., having two floors. The concreting of these buildings was started in July, 1914, and they were entirely roofed in by December, when they were heated and concrete floors and inside foundations, etc., placed during the winter months. The superstructure walls are of plain concrete varying from 18 in. to 8 in. in thickness and the total quantity of concrete in the buildings is 16,625 cu. yds.

Whereas in 1912 the west bank of the river was as densely wooded around Iroquois Falls as the east bank is still, there is to-day every indication of a rapidly growing town of which the mill which we have just described is the nucleus. The town site has been carefully laid out by the company, a landscape architect having been employed for the work. While at the present time the mill is largely surrounded by camps constructed by the com-

Fig. 11.—The Mills as They Appeared on June 21st, 1915.

pany or the contractors, the former has commenced the construction north of the mill of a number of residences, artistic in design and of very architectural styles. Proper regard is being maintained for the physical features of the community, and there is every indication of harmonious results from present care in the lay-out of streets and development of the town site.

Mr. M. J. Leahy is general manager of the Abitibi Power and Paper Co. at Iroquois Falls. The consulting engineer on the above development is Mr. Geo. F. Hardy, of New York. Mr. F. S. James is his resident engineer. The contractors for the whole development are Messrs.

Fig. 12.—Rock Excavation at Power House Site, and View of Concrete Mixing Plant.

Morrow and Beatty, Limited. We are indebted to Mr. L. B. Kingston, B.Sc., chief engineer for the contractors, for the details contained in this article. The entire development will likely be in operation in July.

COPPER ACTIVITIES IN BRITISH COLUMBIA.

In British Columbia the Granby Consolidated Mining and Smelting Company is running its Grand Forks and Anyox plants to full capacity, and arranging to increase the capacity of its Anyox plant to 4,000 tons a day—the same as the Grand Forks plant. It is stated that the B.C. Copper Company's smelter at Greenwood will be again blown in next month, and if operated to full capacity will treat 2,400 tons of ore a day. The Britannia mine is arranging to resume shipments of 600 tons a day and is completing a mill to increase the output to 2,000 tons of ore a day.

The B.C. Copper Company is getting out plans for a concentrating mill at Princeton to handle 1,000 tons a day. The Quatsino Copper Company is getting ready to ship. The Continental Development Company has started shipments from the Rocher De Boule mine to Granby Smelter. The Marble Bay mine on Texada Island, and the Rossland mines of the Consolidated Mining and Smelting Company add to the production, so that within a year the copper production of British Columbia should be doubled and should reach from 100,000,000 to 125,000 000 lbs. a year.

This production will mean the establishment of an electrolytic refinery in the vicinity of Vancouver, the Granby Company having had this industry in view for some time.

WATERWORKS COSTS AT HAMILTON.

THE following tabulated statement shows the difference in cost between the old and new systems of supplying the high level and Mountain districts of the City of Hamilton, with water. The interesting figures are from the report for 1914 of Mr. A. F. Macallum, city engineer. Mr. Jas. Boyd is chief engineer of the high level pumping station, to which these figures pertain. The amounts of water pumped into the high level and Mountain districts were 101,009,760 and 10,906,000 Imp. gal. respectively.

Old System.

Date.	Coal and power.*	Oil.	Packing.	Lighting gas.	Total.
1912					
December	$195.05	$2.50	$4.00	$3.20	$204.75
1913					
January	164.24	2.30	3.00	3.20	172.74
February	167.24	2.08	1.00	3.20	173.52
March	178.89	2.27	5.00	3.20	189.36
April	179.74	2.21	2.00	3.20	187.15
May	156.88	2.30	1.00	3.20	163.38
June	171.94	2.21	5.00	3.20	182.35
July	193.73	2.53	2.00	3.20	201.46
August	190.54	2.30	6.00	3.20	202.04
September	193.97	2.24	2.00	3.20	201.41
October	162.15	2.30	3.00	3.20	170.65
November	158.49	75	1.00	3.20	163.44
Totals	$2,112.86	$25.99	$35.00	$38.40	$2,212.25

*Coal and power means coal for running steam pumps at high level pumping station, also power for Wentworth Street pumping house.

New System.

Date.	Hydro power	Hydro lighting.	Coal† packing and oil.	Totals.
1913				
December	$ 104.69	$ 4.86	$ 46.40	$ 155.95
1914				
January	104.69	4.86	34.80	144.35
February	104.69	4.86	31.90	141.45
March	86.35	4.86	34.80	126.01
April	87.25	4.86	29.00	121.11
May	88.88	4.86	23.20	116.94
June	89.37	7.38	17.40	114.15
July	91.64	7.52	.....	99.16
August	91.70	7.50	.....	99.20
September	102.45	7.57	14.50	124.52
October	89.25	7.77	20.00	117.02
November	81.44	7.80	23.20	112.44
Totals	$1,122.40	$74.70	$275.20	$1,472.30

†Coal used for heating buildings, running small engine in machine shop, banking fires and operating steam pumps for four days during the year.

PAVING IN HAMILTON DURING 1914.

The 1914 report of Mr. A. F. Macallum, City Engineer of Hamilton, records the laying of 155,748 sq. yds. of pavements, of which 120,826 sq. yds. were asphalt; 21,351 sq. yds. asphaltic concrete; 10,326 sq. yds. wood block; 1,438 sq. yds. concrete surfacing; and 1,807 sq. yds. of concrete gutters.

LAYING OF SEWER PIPE.

At the annual meeting last week of the American Society for Testing Materials, Committee C-4 recommended the adoption of the following practice for the laying of sewer pipe:—

I. Preparing Trenches and Foundations for Pipe Laying.—The foundations in the trench should be formed to prevent any subsequent settlement and thereby a rupture of the pipes. If the natural foundation is rock it is recommended that an equalizing sand bed be placed upon the rock and well compacted by watering or otherwise so as to obviate irregular settlement. If the natural foundation is good firm earth, the earth should be pared or molded to give a full support to the lower third of the pipe. Otherwise the bed should be made firm, either by sand well watered or rammed, or by a layer of cement mortar. The same means of securing a firm foundation should be adopted in case the excavation has been made slightly deeper than necessary.

If there is no good natural foundation, a firm and sufficiently broad bed should be artificially made either with sand, with gravel or broken stone, with concrete, reinforced concrete or other means to secure a solid and firm foundation.

If the soil is porous and ground water rises above the sewer pipe, a plank foundation with or without piles may be required.

When the sewer is to be laid in a concrete cradle, the concrete for the full width of the cradle should be continuously deposited to the height of the outside bottom of the pipe. Before the concrete has set the pipe shall be evenly bedded therein and the remainder of the concrete immediately placed on each side of the pipe and carefully tamped in such a manner as to avoid disturbing its position. Or, the pipe may be supported and held in position by wedges or templates and the concrete mixed wet, and poured under and around it in such a manner as to complete the cradle in one operation.

When the sewer is to be laid in a gravel or broken-stone cradle, the material should consist of clean gravel or sound broken stone, all of which should preferably pass through a screen of 1-in. mesh and be retained on one of ½-in. mesh. The gravel or broken stone should be deposited and consolidated for the full width of the trench to the height of the outside bottom of the pipe. The pipe should then be bedded therein and the remainder of the gravel or broken stone deposited and carefully consolidated in such a manner as to avoid disturbing the position of the pipe. The cradles should in all cases be so constructed that an undue proportion of the load shall not be borne by the hubs.

If the trench is situated in ground water, it is recommended to lay the pipe in a concrete cradle up to the springing line.

When a sewer is to be laid without a cradle the earth forming the bed should be carefully freed from stones and organic material. The pipe should then be evenly bedded therein, the joints properly made and the backfilling placed and firmly tamped in such a manner as to avoid disturbing the position of the pipe.

When pipe is laid in soil which is not sufficiently firm to carry it, the earth or soil should be removed, and sufficiently broad foundations and retaining supports substituted.

When pipe is to be laid in new embankment the fill up to a point over the springing line of the pipe should be deposited in layers not exceeding 6 in. and thoroughly consolidated by rolling, ramming, teaming, watering or a combination of these, depending upon the nature of the filling material, whether it is clay, sand, gravel or a mixture of these.

If a pipe line is situated on one side of an embankment where the soil is liable to lateral movements, and is thus subjected to a one-sided load or pressure, care must be taken to secure a stable foundation, so that the pipe line will not be moved on its bed. A retaining support should be placed at the side having the less pressure. It should be made of suitable material, of proper height and weight, to transfer to the foundation the excessive lateral earth pressure, without danger to the stability of the pipe line.

Trenches should be kept free from water until the material in the pipe joints has hardened sufficiently so that the pipe line will be continuous and strong.

The stresses produced in pipe by the backfilling will differ according to the conditions of the soil. In self-sustaining soil it is possible to lay pipe at a considerable depth without producing excessive stresses. In soil which permits of lateral movement or which is water-carrying, special precautions are necessary.

To protect pipe lines from unusual stresses all work should be done in open trenches. Tunneling should be prohibited except with the special consent of the engineer.

Pipe lines should be placed at such a depth below the surface of the street that dangerous pressure or impact cannot occur. If it is not possible to do this, special reinforcement is required.

Rock excavation should be made to a depth of at least 4 in. below the outside bottom of the pipe, or as shown on the plan.

Width of trenches in earth should be sufficient to provide a free working space of from 6 to 12 in., exclusive of spurs and hubs, according to the size of the pipe and the character of the ground.

The width of trenches in rock should be sufficient to provide a free working space of 12 in. on each side of the pipe exclusive of spurs and hubs.

In every case there should be sufficient space between the pipe and the sides of the trench to make it possible to thoroughly ram the backfilling around the pipe and to secure tight joints.

If soil conditions and ground water require the use of sheeting, sheet piling and bracing, the trenches should be made correspondingly wider. The sheeting should be closely driven and to such depths as the soil conditions may indicate.

Steel sheeting may be used with advantage where the flow of ground water into the trenches is excessive and the stability of the foundation soil and of the sewer is affected thereby.

Where a trench for a proposed sewer or extension of a sewer terminates in rock, it should be excavated for a distance of not less than 5 ft. beyond the end of the sewer and in the direction of the proposed extension. The pipes and all other structures should be carefully protected from the effects of blasts.

II. Pipe Laying.—The laying of pipes in finished trenches should be commenced at the lowest point, so that the spigot end points in the direction of flow.

All pipes should be laid with ends abutting and true to line and grade. They should be fitted and matched so that when laid in the work they will form a sewer with a smooth and uniform invert. Unless otherwise permitted

or directed, not less than 20 ft. of pipe sewer should be laid in one operation.

It is necessary to use all possible care when shoving the pipes together, so that mortar will not be shoved into the hub or the joint be unnecessarily large.

Sockets should be carefully cleaned before pipes are lowered into trenches. The pipe should be so lowered as to avoid unnecessary handling in the trench. After the ends of the pipes have been sufficiently wetted, the hub end should receive upon its lower half a layer of mortar composed of one part of Portland cement to one or two parts of fine sand.

The pipe should be set firmly according to line and grade, and the joint carefully adjusted, filled with mortar and finished to a smooth bevel outside. The inside of the pipes should be then cleaned of dirt and mortar refuse. In small pipes the inside should be made smooth by a hand swab. Large pipes should be laid with block and tackle, and bar and tongs.

Gasket and mortar joints should be made in the following manner: A closely twisted hemp or oakum gasket of suitable diameter, in no case less than ¾ in., and in one piece of sufficient length to pass around the pipe and lap at the top, should be solidly rammed into the annular space between the pipes with a suitable caulking tool. Before being placed, the gasket should be saturated with neat cement grout. The remainder of the space should then be completely filled with plastic mortar mixed 1 : 1, and the joint wiped inside and finished to a smooth bevel outside.

Where butt or bevel joint pipes are used, the following method of joining is recommended: After a layer of mortar about 8 in. wide has been prepared at the joints, a wire netting is spread upon the same and covered with a layer of mortar about an inch thick. Upon this wire netting, which is embedded in the mortar, forming a bandage, the pipes are laid and adjusted according to line and grade. The bandage is then raised on both sides of the pipe, bound at the top, and covered with a layer of strong cement mortar at least 2 in. thick. The inside of the joint is finished in the same manner as specified for hub-and-spigot pipes.

The ends of pipes which enter masonry should be neatly cut to fit the face of the masonry.

No pipe or the cradle thereof should be laid or placed until the sub-grade of the trench has been tested and found correct.

In deep cuts, in high embankments or in poor soil, it is recommended to use especially strong pipes or concrete reinforcement.

The smaller sizes of cement or concrete pipes should preferably have flat bases. If of sufficiently large diameter, they may be reinforced.

When mortar or concrete are to be mixed or placed in freezing weather the following precautions are advised: No concrete should be laid when the temperature of the air is below 24° F. When the temperature is between 24 and 32° F., and rising, the mixing water should be heated to a suitable temperature, or, if directed, one per cent. of salt, by weight, should be added for each degree of Fahrenheit of air temperature below 32° F. Under such conditions other materials for concrete and mortar should all be heated.

III. Backfilling Trenches.—All trenches and excavations should be backfilled immediately after the pipes are laid therein, unless otherwise directed. The backfilling material should be selected and deposited with special reference to the future safety of the pipes. Clean earth, sand or rock dust should be used up to a level at least 2 ft. above the top of the pipe. This material should be carefully deposited in uniform layers about 6 in. in depth. Unless otherwise permitted, each layer should be carefully and solidly tamped or rammed with proper tools, so as not to injure or disturb the pipe line. The backfilling material for the remainder of the trenches should contain no stones over 10 in. in their largest dimensions, should be spread in layers and thoroughly consolidated by tamping or otherwise as the engineer might direct. Stones which are used in backfilling should be so deposited through the mass that all interstices are filled with fine material.

Where the safety and stability of the pipe line and other structures render it necessary, sheeting should be left in place, particularly below the top of the pipe.

When sheeting is withdrawn, all cavities remaining or adjoining the trench should be solidly filled. When the sheeting is left in place, all cavities behind such sheeting should be solidly filled.

For retaining backfilling temporarily, timber bulkheads may be used. They should be removed as the trenches are backfilled.

Puddling or water flooding for consolidating the backfilling is recommended only for sandy and gravelly materials. If this method is used, then the first flooding should be applied after the backfilling has been compacted by tamping up to the springing line of the pipe, and the second flooding during or after the subsequent filling of the trench. An excess of water should be avoided, in order to prevent disturbance of the earth under and around the pipe, and also to prevent an undue excess of pressure on the pipe.

Walking or working on the completed sewer, except as may be necessary in tamping or backfilling, should not be permitted until the trench has been backfilled to a height of at least 2 ft. over the top of the pipe.

Where a one-sided pressure exists, due to unbalanced loading, the filling of the trench should be carried on simultaneously on both sides and in such a manner that injurious side pressures do not occur.

In freezing weather backfilling should not contain any frozen lumps of earth below a level at least 2 ft. above the top of the pipe.

THREE NEW BRIDGES PROPOSED FOR WINNIPEG.

Last year the Winnipeg city council directed the city bridge engineer, Mr. P. Schioler, to prepare plans for three new bridges across the Assiniboine River. The plans have been completed and were submitted recently. A bascule lift bridge with concealed counterweights is proposed to replace the existing Main Street structure at an estimated cost of $191,276. Two others with fixed spans, are proposed for Maryland and Arlington Streets, to cost $141,680 and $126,379, respectively.

Special consideration appears to have been given in the design to architectural features, Prof. A. A. Stoughton, of the Department of Architecture, University of Manitoba having charge of the aesthetic treatment. The Main Street bridge is to assume a Gothic type, the Maryland Street bridge is given a Renaissance character by extensive mouldings, etc., and the Arlington Street bridge will be an elaboration of modern design. The Greater Winnipeg Planning Commission has been conferred with relative to the designs and the arrangement of approaches.

THE INGREDIENTS OF CONCRETE AND THEIR CHARACTERISTICS RELATIVE TO BINDING QUALITIES.

AN investigation in which the general nature of concretes and the causes of disintegrations are studied and determined by microscopic examination is the subject of a paper presented at the recent annual meeting of the American Society for Testing Materials by Nathan C. Johnson, consulting concrete engineer, New York. The results of his investigations indicate the underlying causes for the low strength of concrete produced by the best materials, largely because of the considerable presence in the mass of occluded air. They also indicate secondary disintegrating actions aside from such chemical actions as may directly attack the cement, as having a greater importance than is commonly ascribed to them, in concretes exposed to either salt or to fresh water. It is further shown that but a small percentage of the total cement in concrete is hydrated, the greater part lying practically inert in the mass. Also, the influence of surface tension of water as a prime factor in the making of good concrete is demonstrated.

The author refers to the present position of the concrete industry as not unlike that of the steel industry some twenty years ago. Even with the best of raw materials and supposedly uniform and standard conditions of manufacture, the quality of concrete is always uncertain and generally deficient. The making of concrete is hap-hazard, in that it is impossible to predict results; and as the defects of concrete are hidden, so far as outward examination can reveal them, failure or deterioration in service is usually the first intimation of inner structural weakness. But to the aid of the steel industry came structural examination with the microscope and the development of the science of metallography. If the same means can, either directly or indirectly, work to the same end with concretes, so that the strength of concrete can be predetermined, with full reliance placed on its quality and endurance, its uses, the author believes, will be extended an hundred-fold and its right to a pre-eminent position as a structural material established beyond cavil. Unlike steel, however, all the constituent materials of concrete do not lose their identities in the mass. Any concrete, therefore, is dependent for its mass properties upon the sum of a number of individual properties, and any critical studies for the determination of cause and effect necessitates consideration of each of these.

Four substances enter primarily into concrete, namely, stone, sand, cement and water. After the chemical union of cement and water in the forming of the binding substance, a new substance with new properties, in addition to the other substances and their properties, complicates the properties of the mass. These substances must therefore be first studied individually and afterward collectively in order to understand the mass behavior.

Stone.—The large aggregate, broken stone, or gravel —the latter, water-worn stone—may seem too well known to warrant particular study. The word "stone" is synonymous in the popular mind with hardness, durability and resistance to weather conditions, yet all stones do disintegrate, with greater or less facility, according to their composition and structure. Weathered rocks give visual evidence of this. Part of the soil which the farmer tills is disintegrated rock; and the sand grains that form the fine aggregate of concrete are but the component particles of stone which has broken down from a variety of causes, which geologists know well. In utilizing these materials in concrete, therefore, due regard must be had to these matters.

Some stones are indeed natural concretes, sandstone being plainly representative of such. It is very evident from microscopic examination that the stone is built up of tiny particles, which we know to be quartz, cemented together by either iron or alumina or carbonates. In the cementing material between the quartz grains there are the tiny holes or pores, which make sandstone porous; and it is significant of the analogy which these stones bear to artificial concretes that the durability of the stone and its resistance to weathering are in inverse ratio to its porosity. This is to be expected, when it is considered that not only do such pores provide spaces for the retention of water, which will act disruptively if crystallized by freezing, but further that they provide entrance channels for solvents which will attack the cementing material and leave the quartz grains without bond.

Though less analogous than the sandstone to the structure of artificial concretes, limestone is not dissimilar in its arrangement of constituent particles. The structure of trap rock is different, with its compact, but heterogeneous arrangement of minerals, and the structure of granite, with its dissimilar materials in large plates, is strongly veined and apparently possessing cleavages in its minute portions which would need only release from the binding actions of adjacent materials to be made outwardly evident. This finds expression in one way by the behavior of these materials under extreme heat, as in the fire at the Edison plant at West Orange, N.J., whether or not they have had their identities concealed by incorporation in a mass of concrete. Under heat we should expect these dissimilar constituents to expand to different degrees and since the crystals are arranged helter-skelter, with axial expansion in one case normal to axial expansion in another, disruption is likely to occur, if the degree of heat is sufficient. With limestone, of course, somewhat different actions take place, with possible change in chemical composition and resultant disintegration, or spalling; and since the sand grains are in many cases but smaller portions of like materials, it is reasonable to expect the same actions to obtain to a relatively great extent with them as with the larger aggregate. Such actions, multiplied millions of times, in the sand grains and thousands of times in the pieces of stone carried by the concrete of a structural member, such as a column or a beam, must necessarily result in outward spalling or cracking. Concrete is limited in its properties by the properties of the materials of which it is composed; and there is no need to apologize for any behavior of concrete under extreme conditions, when the behavior of these constituent materials under like conditions must, by their nature and structure, be the same.

Sand.—From the analogy as to composition and structure drawn between sand and stone, it follows that the properties of sand as regards strength, compressive or shearing, must closely follow those of stone. Indeed, it is certain that the strength of sand per unit area is not less, and that it is probably greater, than the strength per unit area of stone, since sand is disintegrated stone. Without cementitious material, they have lost the weak portion of the combination—the cement—and possess the strength of the pure material.

Cement.—The third ingredient of concrete is cement. Briefly, this is a more or less definite compound, containing in varying amounts and combined in devious ways a number of chemical radicals, CaO, MgO, SiO_2, Al_2O_3, Fe_2O_3, SO_3, H_2O and so on, some of these compounds

due to the cement materials themselves and others to the secondary addition of gypsum to control the setting. For the present this product will be assumed as satisfactory from the chemical standpoint and no examination made of its microstructure, previous to its admixture with water.

Water.—The fourth ingredient of concrete is water, and despite its familiarity it deserves particular study. Assuming its freedom from substances injurious to concrete, its physical properties have a most important bearing on the production of concrete; and of these physical properties, that peculiarity known as "surface tension" is of special interest.

Briefly stated, surface tension is that balance of molecular forces in water which finds expression in such ways as the formation of spherical particles, as in rain drops. This holds true even in the formation of very minute particles. Each of these particles is a sphere, or at least that each tends to assume the spherical form. If a section through one of these drops were taken. It is evident that since the centre of the drop is higher than the other portions, to maintain equilibrium and resist the action of gravity, there must be inward components acting at the sides. So strong are these components that it seems as if there must actually be a tough skin on the water drop, holding the inner portions in place and resisting its spreading over the surface on which it lies. This finds every-day expression in the reluctance of water to pass over a dry surface, such as that of sand or stone; and it also is the cause of the compacting of sands of varying degrees of fineness with certain quantities of water; and their dispersion, or increase of volume, with other quantities. It is evident on these accounts alone, that the surface tension of water is a factor to be reckoned with in making concrete, for not only will it affect the thoroughness with which the distribution of the cement is effected over the surface of the aggregates, but it will further influence the quantities of the materials contained in a struck measure, which is essentially the manner in which the materials for concrete are proportioned. It also has a most pronounced effect on the thoroughness of the action permitted between cement and water; and as this action produces the binding substance which holds the sand and stone together, it is a prime factor in its collective actions on the strength and durability of concrete. Although seemingly elementary, a thorough understanding of these matters is essential to a comprehension of the formations found by micro-examination of concretes.

Physical and Chemical Reactions.—Briefly, the mixing of concrete involves primarily, a number of physical actions and secondarily, a combination of physical and chemical actions. First of all there are the physical actions of wetting three dry substances—stone, sand and cement—with water; and following this is the formation of a binder through the chemical union of cement and water, with sequent physical action in the spread of this new substance over the surface of the sand grains and stone particles, so that they will be strongly held together. The exact actions attendant upon the production of this binder are somewhat obscure, but they are known to take place in two stages. In the first, the mass loses its plasticity and becomes more or less friable. In the second, consolidation takes place, the mass increasing in hardness until a stony texture is obtained. The first stage is known as "setting," and the second stage, as "hardening."

It follows from the complex character of its composition, that the reactions involved in the setting and hardening of Portland cement are themselves complex. It seems probable, however, that the reactions of setting involve the formation of supersaturated solutions and the deposition therefrom of close-knitted, interlacing crystals of various substances, while the slower reactions of hardening consist partly in the formation of similar interlacing crystallin products, but more especially in the production of a colloidal, or amorphous "gel," or glue, probably colloidal calcium hydrosilicate, with its gradual desiccation.

Obviously, for the proper employment of this binding substance in concrete, there must be (1) thorough reaction between the cement powder and water; (2) thorough contact of the resultant binder with the sand and stone; and (3) a maximum quantity of sand and stone in any given volume, with consequent minimum of binder, since not only is the binder of indefinite composition and properties but it is further the most expensive ingredient of the concrete, inherently the weakest under stress and in addition, the most subject to injurious attack.

MARKET IN ENGLAND FOR CANADIAN WOOD PAVING BLOCKS.

From time to time Canadian manufacturers have looked into the feasibility of supplying wood paving blocks for the use of municipalities in the United Kingdom, and the existing situation has stimulated several recent inquiries regarding this trade. These have referred both to creosoted and uncreosoted blocks.

While some few municipalities might be willing to purchase untreated paving blocks from abroad, more particularly where such bodies do their own creosoting, according to Mr. Harrison Watson, Canadian Trade Commissioner in Great Britain, there appears to be no possibility of shipping already-creosoted blocks to England, if only for the reason that the nature and extent of the creosoting varies considerably according to the views of the different bodies, and also to the particular variety of timber employed. An equally potent reason is that the majority of the municipalities obtain their supplies from resident manufacturers of blocks of all kinds, most of whom possess creosoting plants, and who are not only experts in everything that pertains to the industry, but keeping in constant touch with the engineers and other officials of public bodies and carefully studying their wishes, form a convenient channel of supply with which non-resident block manufacturers would find it difficult to compete.

The majority of these manufacturers cut their own blocks besides attending to the creosoting process, but if sufficient inducement could be offered, it is possible that some of them might be willing to purchase the blocks already cut to dimensions.

It is, however, the opinion of those who have studied the trade, and it seems to be the opinion of Mr. Watson, that Canada would stand a much better chance of supplying the timber than the finished block, and at the present time, when there is difficulty in obtaining supplies of practically all kinds of timber from customary sources, opportunities for Canadian trade are unusually favorable.

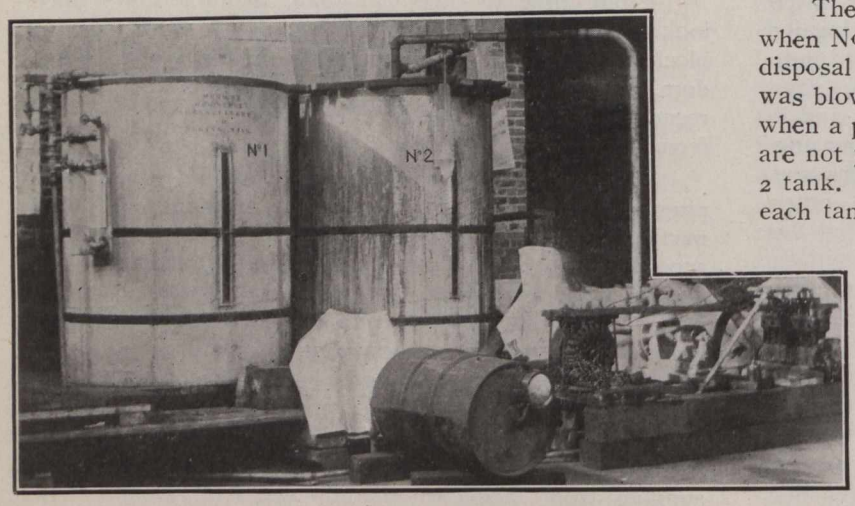
According to the report for 1914 of Mr. A. F. Macallum, City Engineer, the city of Hamilton, laid during that year new water mains as follows: 506 feet of 1-inch; 270 feet of 2-inch; 25,702 feet of 6-inch; 800 feet of 8-inch; and 996 feet of 12-inch pipe. In addition some 53,635 feet of service pipe was installed, ranging from ½-inch to 2-inch in diameter.

ACTIVATED SLUDGE EXPERIMENTS.

By R. O. Wynne-Roberts,

THE City Commissioners of Regina, on the writer's recommendation, authorized experiments to be made on the treatment of sewage on the latest and very promising method. The accompanying reproduction will illustrate the plant installed for this purpose. There are two galvanized iron tanks with glass windows. Each tank is 4 ft. 7½ ins. in diameter and 24 ft. deep, and has a 2-in. outlet pipe secured to the centre of the floor. The capacity of each tank is 105 gallons per vertical foot and about 5 ft. 6 ins. depth of sewage was treated, being about 577 gallons in each tank.

No. 1 tank was treated by straight air blowing. An old Ford automobile engine was converted into an air compressor, and an old steel gasoline barrel was made into an air receiver. The air supply pipe can be seen on the left of the tank. Near the top it is slightly enlarged to allow an orifice plate with ⅜-in. diameter opening to be inserted for the purpose of measuring the air. The air



Experimental Sludge Plant at Regina.

pipes are connected across the top and bottom of the tank so as to equalize the pressure. The distributing pipes at the bottom of the tank are perforated at 6-in. centres and a canvas sleeve inserted over it to diffuse the air. This answered fairly well in the experimental investigations, but something more durable will be required for permanent work. The air receiver smooths out the oscillations due to the compressor and makes it possible to maintain almost an uniform air pressure. As already stated, the air was measured by means of a ⅜-in. circular orifice; the water-gauge, which is not distinct in the photograph, showed the difference in the pressure on the inlet and outlet sides of the orifice plate and computations were made according to recognized formulas.

No. 2 tank was aerated by injecting air. A small centrifugal pump was connected to the central outlet and delivered the sewage back again by the vertical pipe seen on the right of the illustration. The vertical pipe in No. 2 tank has a venturi throat cast inside and the sewage has consequently to pass through the constructed throat at a much higher velocity than it does in the plain pipe. In doing so, draws in air near the elbow and the mixture of sewage and air is driven nearly to the bottom of the tank where it strikes a cone which causes the sewage and air to spread out to the perimeter. The air in this case is measured by a brass plate fixed on the air inlet, and having a ⅜-in. orifice. As the air is drawn in, or is under slight vacuum, the negative pressure is measured by means of a glass tube inserted in a glass vessel and noting the height to which water is raised by suction, or, more correctly, noting the atmospheric pressure and the pressure in the air intake.

The pump was difficult to control under the conditions of the experiment, as too great a delivery of sewage would cause a greater quantity of air to be injected than was required, whilst if the valves were checked they were liable to be choked by the sludge. Consequently, some energy was lost and was converted into heat in the sewage, with the result that the temperature of No. 2 tank rose from 58° F. to 87° F. The temperature in No. 1 tank rose to 68° F., but this was due to the rise of the atmospheric temperature.

The air compressor and centrifugal pump were driven by an old electric motor; no record was kept of the power consumed inasmuch as the pump was not performing its full duty and some of the air was allowed to waste.

This experimental plant is located in a spare part of the boiler room of the power house.

The experiments were started on May 18th, 1915, when No. 1 tank was charged with raw sewage from the disposal works. No. 2 was started on May 20th. Air was blown in one and injected into the other for two days when a pailful of concentrated sewage from houses which are not yet connected to the sewers was poured into No. 2 tank. Three days later another pailful was poured into each tank, and this was repeated about seven times.

No. 2 tank, being warmer, was evidently more active than No. 1, for a copious quantity of froth was generated. In both cases the sludge and liquid changed from dull slate-black color to brown.

The quantity of air intended to be supplied was at the rate of 15 cubic feet per square foot of tank area per hour; this was fairly well maintained in No. 1 tank, but not so well in No. 2 tank, owing to the valves or pump being choked with sludge.

Samples of the tank mixture were taken daily and allowed to stand on a shelf in the boiler room, but no odor was emitted other than that of earth. The sludge subsided quickly, leaving a yellowish supernatant liquor.

While the pails of concentrated sewage were being dumped into the tanks the odor was pronounced, but in less than five minutes no smell was noticed. When it was proposed to locate the tanks in a part of the boiler room the men made objections, but the experiments have been conducted since May 18th and no complaint whatever has been made regarding the operations. The absence of smell was an agreeable surprise to the men engaged in the power house.

The writer's connection with the experiment ceased on May 31st, since when the city engineer, Mr. F. A. McArthur, has had charge.

Acknowledgements are due to Mr. E. W. Bull, the superintendent of light and power, for assistance in the arrangement of the equipment; to Dr. W. W. Andrews, of Messrs. Andrews and Cruckshanks, for suggestions as to diffusors. Messrs. Andrews and Cruckshanks were employed to make analyses but at the time of writing, full particulars are not to hand.

Other Experimental Plants.—On his way east, the writer took the opportunity of visiting Winnipeg to in-

spect the Dickson yeast process, and at Chicago of inspecting the small experimental plant for treating the Packing-town sewage by the activated sludge process. The tanks at Chicago are about 2 ft. in diameter and about 10 ft. deep. The sewage is perhaps the most concentrated and difficult in the States. The air is measured by means of cast-iron casing gas meters.

Dr. Edward Barton, of the Illinois University, has been conducting experiments on the activated sludge process and recently read a paper publishing the results obtained. Since then he has had two small concrete tanks constructed in the basement of one of the buildings of the university. The sewage of the city of Champaign is conveyed by a sewer which passes the side of the above building and sewage is drawn from that conduit for treatment. The tanks are about 3 ft. square and about 10 ft. deep and have been in use a few weeks only, consequently the quantity of sludge necessary to accumulate to secure the best results has not yet been collected. The air is obtained from the compressed air plant of the university and is measured by an ordinary tin-cased dry gas meter.

The writer understands that experiments have been conducted at the Provincial Laboratory in Toronto. The continuous treatment of sewage instead of the fill and draw method has been tried and it remains to be seen what measure of success will be achieved.

The activated sludge process is being tried at Milwaukee, Brooklyn, Baltimore and other places on the American continent, and but for the stupendous war now raging in Europe this process would undoubtedly be tried in many places in that continent.

At Manchester (England), the birthplace of the process, Salford, Wakefield and other places in Great Britain, activated sludge obtained by aeration gives promise of greatly improved effluents at moderate cost.

PROGRESS ON THE KETTLE VALLEY RAILWAY, BRITISH COLUMBIA.

FROM time to time announcements have been made in these columns of the development of the 250-mile Kettle Valley Railway from Merritt to Midway, in British Columbia. The following historical sketch of its construction to date will probably be of interest to many:—

Location work started in 1910, a number of parties being sent out in the early spring. In July of that year the first grading was done at the Merritt end, where a connection is now made with the C.P.R. by the Macdonell-Gzowski company. This company had a contract for the work from Merritt south to Otter Summit, a distance of 30 miles, which they finished in 1911.

At the same time work was being carried out on the Midway section, where Rice and Company had a contract for 35 miles west from that point. This also was finished the next year. Survey work was going on simultaneously, the surveyors having a deal of difficulty in fixing the final location lines. The Kettle Valley road runs across mountain chains instead of paralleling them, as is usually the case with railways, and thus it has to cross three ranges, viz., the Kettle-Okanagan, the Okanagan-Similkameen and the Hope ranges.

A third grading contract was given in 1911, this going to Rice and Company, for the 40 miles from Mile 35 west of Midway to Mile 75, at Hydraulic Summit. This grading was finished in 1912, and the year after the bridges were completed. The same firm got the contract for the section from Penticton to Osprey Lake and finished it in 1912. During that year, also, was completed the section from Hydraulic Summit west to Penticton, a distance of 58½ miles, the work being done by Grant, Smith and Company.

Twohy Bros. graded the 13 miles from Coldwater Junction to Coquihalla Summit, and McArthur Bros. the 40 miles from the latter point to Hope, finishing it in 1914, except for a number of the bridges. In 1913 Guthrie, McDougall and Company got a contract for the grading of the line from Osprey Lake to Princeton, 31 miles, and the work on this was begun and finished in 1914.

The first steel was laid in 1910, by Macdonell, Gzowski and Company, for 10 miles south from Merritt. In 1911 Rice and Co. laid steel for 35 miles west from Midway and another 20 was laid on the Merritt end by the contractors there.

In 1912 Penticton saw its first steel, seven miles being laid west to Trout Creek canyon by Kettle Valley workmen. Another 11 miles of steel was added on the Rice contract stretch from Mile 35, west of Midway, to Mile 46.

The year 1913 saw the finishing of laying of steel from Mile 46, west of Midway to Mile 75, Hydraulic Summit, by the railway itself, K.V.R. workmen that same year also laying seven miles of steel from Hydraulic Summit towards Penticton. In addition, the K.V.R. finished steel-laying from Trout Creek to Mile 40 west of Penticton, being to Osprey Lake, and laid rails as well for 11 miles from Coldwater Junction to Coquihalla Summit.

Last year steel was finished by the K.V.R. between Penticton and Hydraulic Summit, 51 miles being laid. Two additional miles of rails was also put down by the railway on the Twohy Bros. contract at Coquihalla and three miles on the McArthur Bros.' section over the Coquihalla Summit. Another two miles was laid at the Hope end, from the C.P.R. tracks to the river bridge there. This year steel has been finished from Osprey Lake to Princeton; another eight miles has been laid at the Hope end of the cut-off, and two miles more at the upper end, leaving 25 miles to be laid to finish the cut-off line. This work will undoubtedly be finished this year.

The Kettle Valley company is now asking for tenders for the construction of snow sheds on the Coquihalla line to Hope, to be built this year.

There are many large bridges on the line, the largest of all being that which is being thrown across the Fraser at Hope, where the line crosses from the cut-off to the connection with the C.P.R. at Hope. This structure is 960 feet long, having four steel spans of 240 feet each. A highway for pedestrians and vehicles is provided above the railway track deck of the bridge, The bridge was finished this year.

The highest bridge on the K.V.R. is that at Trout Creek canyon, a few miles out of Penticton. It is 245 feet above the water. This steel work on the bridge, which was built in 1913, is 250 feet long and the approaches 450, making a total length of 700 feet.

Two or three of the bridges now under way in the Hope cut-off section are worthy of more than passing interest. There is one over Ladner Creek which is 230 feet high and 600 feet long. Another bridge, over Slide

Creek, is 400 feet long, having a single span of 320 feet. Canyon Creek, east of Princeton, is bridged by a wooden trestle which is 180 feet high.

PRACTICE OF ROAD WORK.*

By R. Drummond.

THIS is an age of standardization. Road materials of most descriptions are standardized, their powers to resist strains and stresses are known, and, given certain conditions, a fairly accurate estimate can be made as to their outcome in the service of the road and their respective merits in carrying new and modern traffic. The time, manner and methods of the application of the materials, however, are yet a largely speculative quantity.

In discussing practices of road work, it must at once be admitted that the practice for urban roads might not, and in a great many cases could not apply to rural roads, and the writer desires it to be understood that those remarks exclude wood, causeway, concrete, or any of the more permanent road foundations, and are confined to macadam work. On this footing, roads, rural and urban, can be dealt with from the same standpoint, and he proposes to deal with the question of the method or practice of laying what is known as water-bound macadam, and which might preferably be called ordinary macadam.

In laying ordinary macadam, the practice of using water with mud or some soft earthy matter for binding or blinding purposes is still prevalent in many districts, and one of the reasons sometimes given for doing so is that the expense of procuring or using better binding materials cannot be afforded. Experience has shown that macadam laid on the mud and water principle is, in the end, the most expensive, and for carrying mechanically propelled traffic gives the poorest results.

For roads carrying a light or medium traffic, an improved system of laying macadam is to bind the metal with whin or granite chippings, and if laid in winter, the moisture in the road will keep the surface quite good until the dry weather permits of tar spraying in the spring. If the metal is laid during summer, the binding should be tar sprayed as the work proceeds. For roads with heavier traffic the same process of metalling should be carried, but if possible, during the summer months only, and the surface consolidated with a more liberal application of tar or bituminous mixture. These methods give excellent results, and if the chippings are accounted as metal, the saving in the work of procuring and applying mud and water, to a considerable extent, meets the cost of the bituminous binder; besides, the extended life of the road surface, resulting from the use of a bituminous binding, effects a material saving.

The practice of covering the road with metal full width at one time is not to be commended. It is impossible to produce a satisfactory surface if the passing traffic is allowed to plough its way through newly laid metal, and it not infrequently happens that no watchman or signal is left to warn road users of the condition of the road surface. In such cases, no wonder there is a general howl by all those who have to pass that way, and have no option to go round by another road, as is frequently possible in urban areas. On very secondary or third-rate roads, full width coatings may be laid without inconvenience, but where the road is of any importance—the plea of not wide enough not excepted—the method of coating half width at a time is much preferable; by no other means can the metal coating be well and truly laid, and a properly finished surface obtained.

Another important factor in the practice of road work is the proper and discriminate use of the steam road roller. Too much rolling previous to the metal being properly packed, sets up an irregular, wavy surface, and particularly so where mud and water are used as the binder. Rolling and metalling in half widths permit of proper care being exercised in workmanship, and keeping traffic from passing over the metal until in a proper condition to receive it. This practice involves a watchman, and the rolling plant left on the road, to guide the traffic out with working hours and over night, also to guard the new coating previous to its becoming set or consolidated. It also is economical in respect that no time is lost removing the roller at night or fetching it in the morning. As a set-off to the expense of providing a watchman, a full day's work on the road is obtained, and the public are warned and guarded against unrolled metal, which gives rise to frequent complaints.

An old-fashioned practice of keeping a round contour and open water channels along the sides of the carriageway is no longer feasible. If a bituminous binder is used, great care must be exercised in strengthening the sides and forming a side resistance to keep the metal from creeping laterally, or, failing provision in this direction, the benefits accruing from a bituminous-bound surface are quickly lost. Even an open side ditch near the fence may be a source of weakness, and great advantage may be derived by piping and filling up the open ditch, thus the surface water is quickly disposed of and the road weighted to help in keeping the carriageway from spreading. On roads carrying heavy traffic, resort may be had to more drastic means, by laying a line of heavy submerged stones or curb, to stop the spreading process. In the town or urban area this is unnecessary, as the sidewalk, with its curb and channel, fulfils that purpose.

Of no less importance in the practice of road work is the grading and spreading of the metal. In the writer's experience, each grade or size should be separately applied, instead of first mixing the various grades into one mass before application. Good spreading is of first importance, and it is very difficult, if not impossible, to make good work from a mixture.

In dealing with the results to be obtained, there is always the human element to consider. Men of aptitude and skill must be obtained, and trained to the work, they must be directly employed and encouraged to remain in the service. The time when any kind of man was thought to be fitted for road work is gone, and without a full and efficient staff, road work can never be properly executed.

It is not proposed to refer to practices in connection with roads carrying extremely heavy traffic; such roads require special treatment, special materials and special machinery. The aim of these notes is rather to bring under review the work and practice as carried out on the average roads throughout the country, and where ordinary metal coatings, if properly laid and properly bound with some sort of binder other than mud and water, would be capable of carrying satisfactorily a large volume of traffic and meet all requirements at the present time. In conclusion, it is timely to note and emphasize that experience and time have now proved beyond a doubt that the newer methods or practices are essential for modern requirements, and that they are a real economy.

* From a paper prepared for the annual meeting of the Institution of Municipal and County Engineers at Ayr, on 4th and 5th June, 1915.

POSTS FOR DOMINION SURVEY WORK.

SOME changes have recently been made and a new corner post for township and quarter-section corners is under consideration. The practice now is to use iron posts at all corners with mounds or trenches when possible. Where mounds or trenches cannot be built on account of water or the marshy nature of the ground, a long post of wood, not less than 5 inches in diameter, is to be used. Where it is inconvenient to dig a trench, owing to rock outcrop, "stone mounds" are built, with an iron post when it is possible to drive one. The changes in corner monuments have been frequent in the past thirty years.

A committee appointed at the annual meeting of the Dominion Land Surveyors' Association, held in Ottawa, January, 1915, to inquire into the matter of a better post for use on Dominion land surveys, report that, in their opinion, a post might be designed with an expanded or bulbous portion on its lower end, which could be driven flush with the ground, and which would in a very large percentage of cases be proof against removal without a shovel or other tools.

If the principal requirement of the desired post be that it cannot be removed under any circumstances without spade or shovel, the post with a plate on the lower end is the most practical. For frozen ground it will be advisable to carry special tools for this, and if the work is not to be delayed extra help will be necessary.

Apart from the question of transportation and the difficulty of planting the post correctly on line and to a depth of thirty inches (due to roots, gravel, boulders, frozen ground and water, especially in the spring of the year) there is no question but that the best post is one modelled after the pattern of those used on the United States surveys. The question of transportation, however, is a serious one (especially where work is to be done by man packing), and should not be lost sight of when deciding on the post to be used. Where transportation is done by horses, the difficulty could be overcome by supplying additional horses.

When the ground is frozen, as it is for the greater part of the year in northern Canada, an extra man would be required for each transit party to plant the post. This man should be intelligent and honest, and even then the surveyor will have to exercise great care to insure the posts are placed correctly on line.

It is the unanimous opinion of the committee that on account of transport difficulties, the plates for the top and bottom of the post should not, on any account, be permanently fastened to the post till the camp is reached from which the posts will be placed. If the surveyor himself is held responsible for the assembling of the post, as he can easily be, before it goes on the line at all, there would be no danger of the plates not being used. Although many ways of construction might be adopted, the one suggested by the committee is as follows: A post of one-half inch pipe, not less than twenty inches and not more than thirty inches long, a bronze top to be secured to post by a through rivet, a lower plate of three inches to four inches diameter, secured by a through rivet or held between a ring or knob worked on the post and the end, which could be riveted or burred over.

If the post is to be filled with concrete it should be done before being supplied to the surveyor.

Referring to the tools necessary to dig the hole in frozen ground: The Bell Telephone Company have tried every known method, even using gasoline power drills and gunpowder. The only satisfactory method, and the one now used by them, is to employ a drill of octagon steel, about one inch diameter, and nine feet long, on each end of which is worked a hardened drill-shaped chisel. A spoon shovel is used for removing the earth. Two difficulties have to be overcome before these tools can be made suitable for use on surveys: That of transporting the long drill rod and that of sharpening the tool when dulled. These difficulties might be partially overcome by having the bar made in two sections and extra bits for screwing on the rods as they become dulled with use. As the joints must be very strong and tight on account of the jarring and prying which the bar will have to undergo in use, it would be necessary to make the joints large and heavy, and it might be even advisable to apply heat in placing or removing the ends to secure a tight joint.

A post-hole auger might be used in places in the summer, after the ground is thawed.

In the winter and at all times when the ground is frozen, there is no question that on a base line party another man would be required to place the post and that for the extra weight to be carried, and on account of the party being increased by the addition of one man, two more horses would be required.

On subdivision work, it is probable that the addition of an extra man for each transit party and one extra horse would be sufficient.

The members of the committee are I. J. Steele, Geo. H. Watt, G. J. Lonergan, and J. R. Akins.

The annual reports of 1882, 1886 and 1908, and the different editions of the Manual of Survey published in 1871, 1881, 1883, 1890 (preliminary 4th edition), 1892, 1903, 1905, 1910 and 1913 by the Surveyor-General, Dr. E. Deville, Ottawa, contain the following general notes:

1. Iron posts at township corners (since 1881 placed at all township corners) have, when mound was built, always stood at the northerly angle or side of mound (correction line) and never in the centre.

2. Iron posts at section corners in bush (since 1890) have always stood at the northerly angle of mound or side of mound (correction line).

3. Iron posts with tins were placed at section corners on the prairie (from 1882 to 1886) in the centre of the mound; tins were discontinued after 1889.

4. Wooden posts in connection with mounds were placed in the centre up to 1889.

5. From 1887 to 1889 no earth mounds were erected.

FORMATION OF ASPHALT.

A theory of the formation of beds of asphalt has been worked out by R. M. Bird and W. S. Calcott, of the Philosophical Society of the University of Virginia. Their experiments indicate that the asphalt results from the oxidation of mineral oil through the action of catalytic agents, and they find that this explains the Peruvian deposits, in which layers of vanadium sulphide and oxide alternate with asphalt. In this case, the vanadium sulphide is the carrier of oxygen to the oil. Ground water solutions of vanadates, it is assumed, are brought into contact with oil containing hydrogen sulphide, and the vanadium sulphide thus produced may be carried along by the oil and deposited with it. The laboratory experiments have proven that in such accumulations the presence of the vanadium compound would rapidly change the oil by means of oxygen drawn from the atmosphere.

PROPOSED STANDARD DEFINITIONS OF ROAD AND PAVEMENT MATERIALS.*

Bituminous Materials.—Asphalts.—Solid or semi-solid native bitumens, solid or semi-solid bitumens obtained by refining petroleum, or solid or semi-solid bitumens which are combinations of the bitumens mentioned with petroleums or derivatives thereof, which melt upon the application of heat, and which consist of a mixture of hydrocarbons and their derivatives of complex structure, largely cyclic and bridge compounds.

Asphaltenes.—The components of the bitumen in petroleums, petroleum products, malthas, asphalt cements and solid native bitumens, which are soluble in carbon disulphide but insoluble in paraffin naphthas.

Blown Petroleums.—Semi-solid or solid products produced primarily by the action of air upon liquid native bitumens which are heated during the blowing process.

Carbenes.—The components of the bitumen in petroleums, petroleum products, malthas, asphalt cements and solid native bitumens, which are soluble in carbon disulphide but insoluble in carbon tetrachloride.

Cut-Back Products.—Petroleum or tar residuums which have been fluxed with distillates.

Tars.—Bitumens which yield pitches upon fractional distillation and which are produced as distillates by the destructive distillation of bitumens, pyrobitumens or organic materials.

Coal Tar.—The mixture of hydrocarbon distillates, mostly unsaturated ring compounds, produced in the destructive distillation of coal.

Coke-Oven Tar.—Coal tar produced in by product coke ovens in the manufacture of coke from bituminous coal.

Dehydrated Tars.—Tars from which all water has been removed.

Gas-House Coal Tar.—Coal tar produced in gas-house retorts in the manufacture of illuminating gas from bituminous coal.

Oil-Gas Tars.—Tars produced by cracking oil vapors at high temperatures in the manufacture of oil gas.

Pitches.—Solid residues produced in the evaporation or distillation of bitumens, the term being usually applied to residues obtained from tars.

Refined Tar.—Tar freed from water by evaporation or distillation which is continued until the residue is of desired consistency; or a product produced by fluxing tar residuum with tar distillate.

Water-Gas Tars.—Tars produced by cracking oil vapors at high temperatures in the manufacture of carburetted water-gas.

Normal Temperature.—As applied to laboratory observations of the physical characteristics of bituminous materials, is 25° C. (77° F.).

Solid Bituminous Materials.—Those having a penetration at 25° C. (77° F.), under a load of 100 g. applied for 5 seconds, of not more than 10.

Liquid Bituminous Materials.—Those having a penetration at 25° C. (77° F.), under a load of 50 g. applied for 1 second, of more than 350.

Semi-Solid Bituminous Materials.—Those having a penetration at 25° C. (77° F.), under a load of 100 g. applied for 5 seconds, of more than 10, and a penetration at 25° C. (77° F.), under a load of 50 g. applied for 1 second, of not more than 350.

Flux.—Bitumens, generally liquid, used in combination with harder bitumens for the purpose of softening the latter.

Asphalt Cement.—A fluxed or unfluxed asphalt specially prepared as to quality and consistency for direct use in the manufacture of bituminous pavements, and having a penetration at 25° C. (77° F.) of between 5 and 250, under a load of 100 g. applied for 5 seconds.

Straight-run Pitch.—A pitch run to the consistency desired, in the initial process of distillation, without subsequent fluxing.

Native Asphalt.—Asphalt occurring as such in nature.

Consistency.—The degree of solidity or fluidity of bituminous materials.

Artificial Asphalt.—Recommended that the use of term be discontinued.

Road Asphalt.—This is a trade term not subject to definition.

Liquid Asphalt.—This is a trade term not subject to definition.

Non-Bituminous Materials.—Chert.—Compact silicious rock formed of calcedonic or opaline silica, or both.

Crusher-Run.—The total unscreened product of a stone crusher.

Granite.—A granitoid igneous rock consisting of quartz, orthoclase, more or less oligoclase, biotite and muscovite.

Granitoid.—A textural term to describe those igneous rocks which are entirely composed of recognizable minerals.

Matrix.—The binding material or mixture of binding material and fine aggregate in which the large aggregate is embedded or held in place.

Rubble.—Rough stones of irregular shapes and sizes, broken from larger masses, either naturally or artificially, as by geological action, in quarrying, or in stone cutting or blasting.

Soil.—A mixture of fine earthy material with more or less organic matter resulting from the growth and decomposition of vegetation or animal matter.

Stone Chips.—Small angular fragments of stone containing no dust.

Tailings.—Stones which after going through the crusher do not pass through the largest openings of the screen.

* Submitted by Committee D-4 on standard tests for road materials at the 18th annual meeting last week of the American Society for Testing Materials.

The United States Bureau of Standards has evolved a device for accurately indicating very small deflections of a steel bar 3 ft. long and 3½ in. in diameter. The bar is supported at each end and a small mirror is fixed at the centre, above which is a frame bearing another partially silvered mirror, both of which reflect the light of a sodium burner, the lower mirror showing a series of black and yellow concentric rings. The slightest pressure on the bar—even the weight of a visiting card or a pin—causes these circles to expand outward, forming as it were a series of ripples like those made when a stone is dropped into the centre of a still pond. The pressure of one finger on the bar causes the formation of five or six new circles, showing that the bar has been bent about 1/20,000 in., as each new circle means a 1/100,000 in. movement.

Editorial

HYDRAULIC ACTIVITIES IN QUEBEC.

The province of Quebec is undeniably rich in water powers. The Cedars Rapids, Shawinigan, Laurentide and other numerous developments show the extent to which these resources are being put to practical use. Another important phase to be taken into consideration with respect to many of the rivers of the province is the logging industry, and this, in conjunction with hydro-electric development, has created a number of important problems in water regulation. One of these is the St. Maurice storage project to which the Quebec Streams Commission has given much study, and for which a concrete dam 1,720 ft. long, near La Loutre is projected to store the run-off from a basin of 3,650 sq. miles. La Loutre is in the wilds of northern Quebec, 40 miles east of Parent, on the Transcontinental and 52 miles up the river from Weymontachingue. The proposed storage works create a very difficult problem in the matter of transportation of construction materials. Tenders were in on June 15th and a contract will probably be awarded very shortly. While the project is one of storage and river regulation a small power-house is included to furnish power for operating the gates, cranes, etc., and for lighting and heating. The reader is referred to *The Canadian Engineer* for August 13th, 1914, where a complete description of the enterprise appears.

The Quebec Streams Commission has under contemplation a similar storage of the drainage basin, 3,931 sq. miles in area, of Lake St. Francis. Many industrial centres are located in the valley of this river, and there are a number of water powers, several of which have been developed. The spring floods caused great damage, while shortage of water in summer and winter is a serious loss to industry. The scheme, which will involve an expenditure estimated at $400,000, will regulate the river flow and incidentally provide 21,810 h.p.-years.

Another project is under way to develop power for the cities of Quebec and Three Rivers and for the various counties in that section of the province, viz., Quebec, Levis, Beauce, Dorchester, Port Neuf, Montmagny, Megantic, Champlain, St. Maurice, Charlevoix and Saguenay.

Little is known of this proposition, as the company was incorporated less than two weeks ago. Some very prominent hydro-electric engineers and financiers are behind it, including Messrs. M. L. Hersey and Julian C. Smith, as engineers, and Mr. Howard Murray as manager.

Of still greater interest, however, is the enterprising development contemplated by the Quebec Development Co., another new concern reported to have behind it a prominent $75,000,000 United States company. It is projecting a very large power development that will utilize the entire discharge and difference of elevation between Lake St. John and the Saguenay River. This is one of the chief tributaries of the St. Lawrence, and flows out of St. John Lake by two channels, the Grand Discharge and the Little Discharge, which unite about nine miles below the lake. The total drainage area is 35,900 sq. miles.

The project comprises two plants, one at Ile Maligne of about 100 ft. head, and the other at the foot of the discharge, where the fall is of about 200 ft. head, and where the Saguenay is at the sea level. The power possibilities as they are at present will be increased by water storage in Lake St. John, which has an area of about 400 sq. miles. The minimum flow of the river will thus be very largely increased.

The development includes 12 hydro-electric units of 50,000 h.p. each, aggregating 600,000 h.p.

We understand that this unprecedented development of electrical energy is to be utilized entirely in the industrial production of nitric acid and nitrates from the direct combination of atmospheric oxygen and nitrogen.

If all this is true of the Province of Quebec, and we understand on good authority that the project is past the preliminary stages of design and that the details of machinery are at present being worked out, it is an admirable answer to M. Pitaval, the French civil and mining engineer, who is credited with writing in "Le Journal du Four Electrique" that Canada, notwithstanding her water-falls, need not be considered as a serious competitor of the other countries rich in water powers, or of the world's electro-chemical industry.

ROAD IMPROVEMENT FROM TORONTO EASTWARD.

The Toronto-Oshawa road should be started this summer. The municipalities concerned adopted the recommendations of W. A. McLean, C.E., Chief Engineer, Ontario Office of Public Roads, who presented his report at a meeting on June 1st. He recommended a macadamized road from Toronto east through Scarboro' Township and an improved gravel road the rest of the way. The estimated cost is $237,000. The suggested division of cost is as follows: York County Commission, $80,000; Ontario county, $11,400; Provincial subsidy, $57,840; Toronto, $43,380; Pickering Township, $20,900; Whitby W., $4,400; Whitby E., $5,500; Whitby town, $2,500; Oshawa town, $8,000. Debentures could be issued by the municipalities to meet these expenditures.

A committee is now endeavoring to get the required three-fourths of the municipalities concerned to petition the Government for co-operation. If this is accomplished the Government will pay forty per cent. of the cost of construction and twenty per cent. of the maintenance charges, with one-quarter of the salary up to $600 of any superintendent of good roads appointed by a municipality.

The municipalities appear to fully realize what a good road will mean to them and there is little doubt that the necessary percentage of approvals will be forthcoming. If delays can be avoided, there should shortly be another road under construction which, like the Toronto-Hamilton highway, would be another step toward the solution of the problem of the unemployed.

The projected Ottawa-Prescott road, approximating 40 miles of length, if proceeded with, would also provide a large amount of work for those who are particularly in need of it.

TORONTO-HAMILTON HIGHWAY CONSTRUCTION

NOTES ON THE THIRTY-FIVE-MILE CONCRETE ROADWAY ALONG THE NORTH SHORE OF LAKE ONTARIO BETWEEN TORONTO AND HAMILTON — PROGRESS OF CONSTRUCTION TO DATE.

THE accompanying plan and views of preliminary grading and hill-cutting relate to the work that is under way on the construction of a 35-mile stretch of concrete road by the Toronto-Hamilton Highway Commission. The proposed interurban highway, to join the cities of Toronto and Hamilton is, for the most part, along the route of what has previously been known as the Lake Shore Road, the improvement of which has been advocated for years. The benefit accruing from the present construction will not be one so much of service to automobile traffic along the scenic lake front as to provide easy access to the cities for the numerous fruit and vegetable farmers who have long desired a suitable market road. Their incessant demands, extending over years, for improvement to the old road, received a decided impetus upon the issuance of the 1914 report of the Public Roads and Highways Commission of Ontario. The Commissioners strongly emphasized the need of a road of more permanent construction, and at the 1914 session of the Legislature their recommendations were adopted to make a traffic survey and to locate the most favorable route.

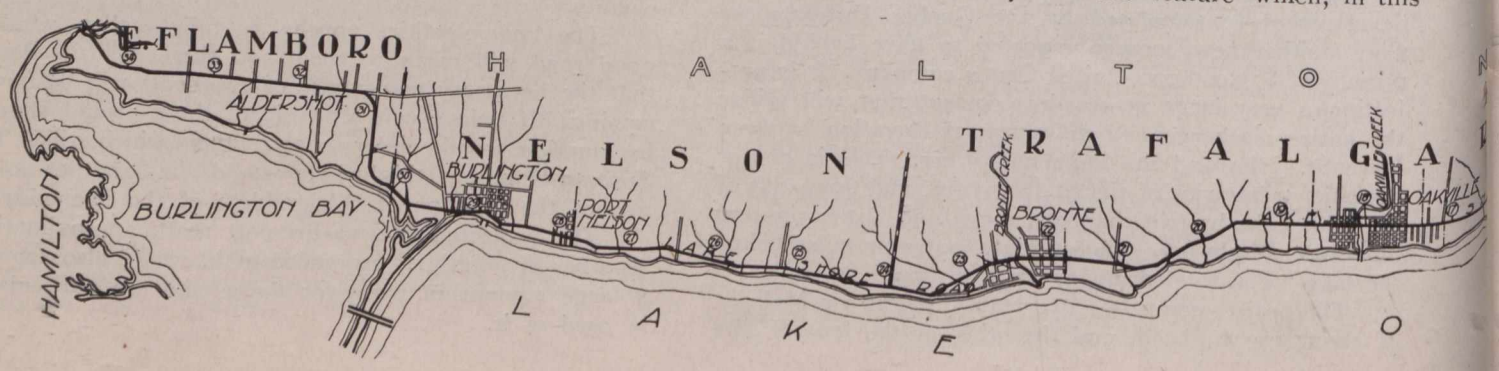
Wheel Scrapers Engaged in Hill-Cutting Near Lorne Park.

The engineering staff of the Provincial Department of Public Roads, of which W. A. McLean, C.E., is chief engineer, made these surveys during the summer of 1914.

In September the government appointed a commission, to be known as the Toronto-Hamilton Highway Commission, to apportion the cost of a paved highway, to decide upon its location, to select a type of pavement that would best meet the conditions to which it would be subjected, and to proceed with the construction of the road. The Commission projected a 66-ft. right-of-way with an 18-ft. concrete pavement (except within town limits, where the width varies to 50 ft. through Oakville) with 3-ft. shoulders of earth and crushed stone. The pavement is to be 8¼ inches thick at the centre, diminishing to 6 inches at the sides.

To defray the cost of the road, debentures to the amount of $600,000 have been authorized. The cost is apportioned as follows: Toronto, $150,000; Hamilton, $30,000; the Ontario Government, 25 per cent. of the cost, not exceeding $4,000 per mile; the municipalities, a general contribution of $4,000 per mile, and in addition a contribution based on a frontage assessment, sufficient to take care of any excess in cost for the amount provided by the means just mentioned.

On November 4th, 1914, Mr. H. S. Van Scoyoc was appointed chief engineer to the Commission. Work commenced on November 8th and about 375 men were employed during the winter, construction camps having been established at Indian Point and Lorne Park. The work consisted chiefly of hill-cutting and filling. In the spring the working force was increased to over 500 men and new camps were established at Port Credit, Lush's Corners, Oakville, Bronte and Waterdown, with material yards adjoining railway tracks at Port Credit, Oakville and Waterdown. From the latter points dinkey engines, of which the Commission have three of the type illustrated, and dump cars, 100 in number, transport construction materials over a 24-inch gauge track, to and along the shoulders of the road. This system of mechanical transport of materials in road construction is a distinctly unusual feature which, in this



particular instance, is estimated to reduce haulage costs by about $60,000, exclusive of plant value upon the completion of the project. About 20 miles of service track will be in continual operation during the work.

Plowing and Grading on the Plains Road.

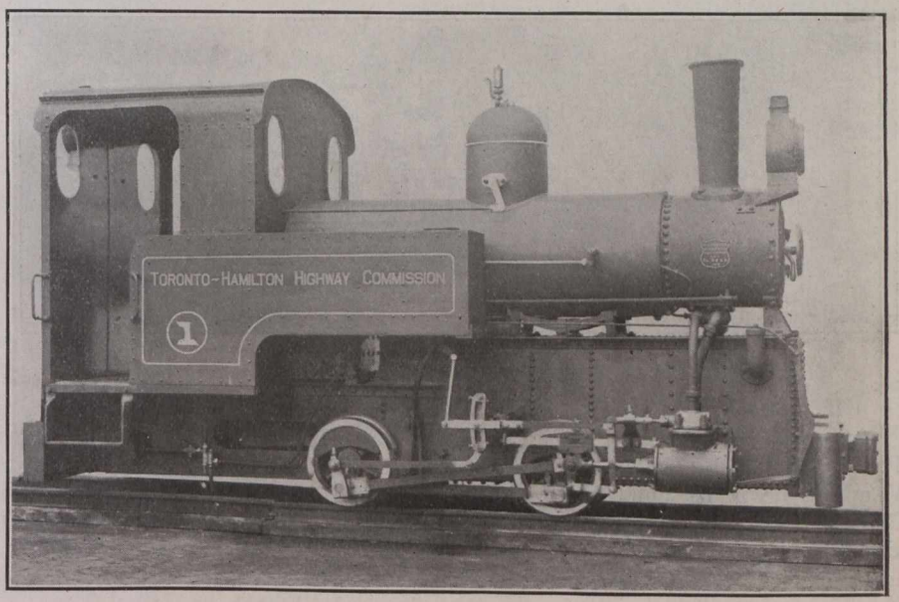
At the present time the work of grading is practically complete and about 20 miles of foundation are ready for concrete. The maximum grade is 4 per cent. on a stretch of road in the vicinity of Lorne Park. Radii of curvature are not less than 200 ft. There are several diversions for purposes of avoiding sharp turns and, in a few instances, of shortening the mileage. One is at mileage 21, east of Bronte, where some sharp turns have been eliminated, and another at mileage 23 to prevent danger of wave action on a portion where the existing road closely approaches the shore line. At Burlington, also, a small diversion is made to better connect with intersecting roads.

Entrance to Hamilton is at present along a road which descends by steep and sharp windings to the level of Burlington Bay. It crosses the Des Jardins Canal and passes under a railway line whereupon it ascends heavy grades and curves. Several proposals have been advanced to obviate the difficult crossing, ranging from a high level bridge 1,400 ft. long and estimated to cost $410,000, to a large fill and smaller bridge to cost about $110,000. The Commission have not made a final decision as to this portion of the highway.

The eastern terminus of the present project is 424 ft. west of the Humber River. From this point westerly to Etobicoke Creek, a distance of 5 miles, is a stretch of road improved several years ago by the York County Road Commission. Part of it has a concrete base and bituminous surfacing. It is possible that this road may be torn up and re-paved to conform with the new construction, but no definite plan has been decided upon up to the present.

While the grading has been done largely with wheel scrapers drawn by horse and mule teams, the Commission have four gasoline-driven Sawyer-Massey tractors, two of which are working scarifiers and the other two graders.

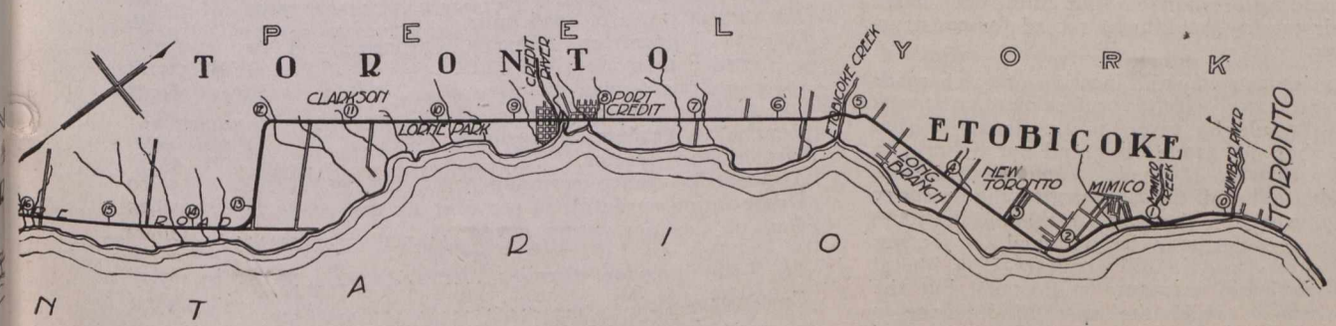
Concreting commenced last week and will soon be in full swing, an additional force of 200 men being added. Five half-yard Austin cube mixers are used on the road proper, and several smaller mixers are engaged in culvert work. When all the units are in operation, it is expected that they will lay over half a mile of concrete road per day. Water supply is provided through 2-inch pipe laid along the road from four pumping stations erected by the Commission.



Type of Construction Locomotive Used by the Commission.

Drainage in general will be by open ditches, although in special cases tile drain will be built.

The concrete will be mixed approximately in the proportion of one part cement to 1½ parts fine aggregate to 3 parts coarse aggregate. The coarse aggregate will vary in size between the part retained on a ¼



Route of the New Concrete Highway to Connect Toronto and Hamilton.

mesh, and that passing a ring having a 2-inch opening. The fine aggregate will pass ¼ mesh.

The expansion joints will consist of a central portion of liquid bituminous material enclosed by felt impregnated with bituminous material. They will be placed approximately every 35 feet.

It is the present intention to have a minimum width of 26 feet on the culverts. This minimum width will be increased as far as bridges are concerned, to provide for at least one sidewalk.

It is estimated that the materials used in the construction of the road will include 150,000 tons of crushed stone, 75,000 tons of sand and 125,000 barrels of cement.

Hill-cutting and Grading Near Clarkson's.

Mr. Geo. H. Gooderham, M.P.P., is chairman of the Toronto-Hamilton Highway Commission, and Mr. H. S. Van Scoyoc is its chief engineer. Under him Messrs. Chas. Johnston is division engineer; R. T. Bell superintendent of construction, and Westropp Armstrong, bridge engineer.

The road will be ready for use over its entire length before the close of next year.

Saskatchewan is spending about $5,000,000 this year on railway construction, in spite of the war. This money has been ear-marked in respect to its disbursement; but generally it may be said that the Government has subsidized several companies for the building of short or spur lines, each small in itself, but, in their totality, making a record for construction in a single year.

There is no good reason why the location of earth roads should not receive the same careful professional treatment by the engineer that would be given to the location of a railroad. The facts that the grade limit and curve limit on earth roads is higher than on railroads, and that funds are never any too abundant, make all the more urgent the necessity for good professional work on the part of the engineer, to the end that the best results may be obtained. It is not difficult to locate a cheap road in hilly country if a liberal use is made of the maximum curvature and grade, but the good location is the one in which the least possible use is made of the maximum curvature and grade and the cost of construction still held to a reasonable figure.

PROGRESS ON VICTORIA HARBOR WORKS.

Practically half of the large arm of the breakwater which the Department of Public Works of the Dominion Government is having built in connection with the construction of the new harbor works at Ogden Point has been completed. The substructure is built of large granite blocks, preparation for the foundation of which, together with the levelling of the resulting surface, is executed by a staff of divers. The superstructure is of reinforced concrete.

The granite boulders are transported from scows along the completed section of the breakwater by steam railway, and placed in position by floating cranes. Much difficulty is experienced in securing solid construction owing to the silty nature of the foundation.

A new record for laying the granite was established during the month of May. According to Mr. J. S. Maclachlan, supervising engineer for the Department of Public Works, a total of 7,253 tons of granite block and 19,022 tons of rubble were placed and 1,344 cu. yds. of concrete superstructure completed. Figures showing the quantities placed to date are as follows:—

Rubble dumped, 634,441 tons; finer material for the core, 241,925 tons, making a total of 876,366 tons since operations were started; granite blocks laid, 42,413 tons; concrete laid, 8,679 cu. yds. Sir John Jackson and Son, Limited, are the contractors.

The firm of Grant, Smith and McDonell, contractors for the Government piers now under construction inside the shelter of the breakwater at Ogden Point, are also making rapid progress on the contract.

The engineer's figures show that a total of 4,357 tons of broken stone was dumped for the foundations of the piers during the month of May.

The reinforced concrete cribs are under construction at Rosebank.

COST OF ROAD BUILDING WITH TRACTOR.

N. Y. Taylor, engineer for Meeker County, Minnesota, has compiled figures showing the cost of building roads in that county with the tractor rig consisting of engine and two graders. He states that this computation includes every item of expense connected with the work, except surveying.

Number of working days	102
Number of miles of road built	36
Wages of operators—foreman, engineer, and two grader men	$1,331.14
4,401 gallons Crown gasoline	580.93
403 gallons lubricating oils	129.78
Repairs to graders, sharpening, etc.	52.00
Repairs on tractor	43.68
Accident insurance premium	50.00
Depreciation on outfit, 25 per cent. on cost of $3,713	928.25
Cost of shed for winter cover	150.00
Total cost for 36 miles	$3,265.78
Cost per mile	90.71

The road was a standard 20-ft. roadway and 36 ft. from edge to edge of the side ditches.—Better Roads and Streets.

COAST TO COAST

London, Ont.—The official opening of the London and Port Stanley Railway will be held on July 22nd.

Montreal, Que.—The Southern Counties Railway is building a 16-mile line between St. Cesaire and Granby. The system takes in the counties of Vercherts, Rouville, Shefford, West Shefford and Chambly. A sub-station will be built at Granby. Mr. W. B. Powell is the general manager of the company.

New Toronto, Ont.—Now that the towns of New Toronto and Mimico have completed an agreement whereby the former will supply the latter with water from its new plant, the installation of mains will proceed immediately. The supply contracted for will range around 50,000 gal. per day.

Winnipeg, Man.—The 18,000,000 gallon reservoir on McPhillips Street, constructed two years ago at a cost of over $230,000, has been giving a little trouble owing to leaks in the foundation. The structure is built of reinforced concrete and is 570 ft. long, 480 ft. wide, with a depth for water of 18 ft.

Ottawa, Ont.—The Ottawa-Prescott highway scheme is progressing. The present estimate for its construction is $10,000 per mile. Ottawa's share is not to exceed $180,000. The government may, under the terms of the general act, contribute a sum not to exceed $4,000 per mile toward its construction.

Halifax, N.S.—The new union passenger station is to cost $1,000,000. It is being built of native granite, and will be one of the large and impressive features of the city. The work on the big ocean terminals and for which $8,000,000 worth of contracts have been let, proceeds with vigor, giving employment to about 1,000 men.

Hamilton, Ont.—The County of Wentworth, taking advantage of the new Highway Improvement Act of Ontario, is preparing to construct a number of main roads. It is not likely that any of them will be started this year, however. The estimated cost of about 18 miles of road contemplated is $288,000. Concrete is being considered.

Niagara Falls, Ont.—Three additional units are being installed by the Canadian Niagara Power Co. The turbines have been designed by the company's own engineers and the parts are being supplied by various manufacturers in Canada and the United States. The generators have been ordered from the Canadian Westinghouse Co., Limited.

Brantford, Ont.—The city has offered to sell the Grand Valley Railway, from Paris to Galt, to the Lake Erie and Northern Railway, now controlled by the C.P.R., in return for the electrification of the Lake Erie and Northern Railway from Port Dover to Brantford, payment of $30,000 and retention of the Blue Lake line material for the Grand Valley. The C.P.R. has offered $26,000 and electrification of the Galt to Brantford part of the L.E. and N.

Anyox, B.C.—The enlargement of the smelter at Anyox by the Granby Smelting and Refining Co. and additions to the plant at Observatory Inlet, which are expected to be completed in the fall, will give the Granby a capacity of 50,000,000 to 55,000,000 lbs. of copper annually. This represents a larger output than that of all the other copper mines and smelters of British Columbia combined, it is stated, and the two Granby smelters will be the largest in the British Empire.

Victoria, B.C.—Tests made following the opening of the Sooke Lake waterworks system have demonstrated that the capacity of the flow line between Sooke Lake and Humpback Reservoir is 21,600,000 gallons per twenty-four hours. In a report to the city council recently Water Commissioner Rust stated that the above quantity was the capacity of the forty-two-inch concrete pipe line. The original specifications on which the work was projected called for a pipe of a capacity of 16,000,000 gallons and of a diameter of forty inches. But later this diameter was raised to forty two inches, the Pacific Lock Joint Pipe Company having agreed to give the larger size pipe at the same cost as the lesser.

Toronto, Ont.—Sir Adam Beck, chairman of the Hydro-Electric Power Commission of Ontario, announces that during the past half-year the average daily power consumption has been 75,281 h.p. The contract with the Ontario Power Company provides for 100,000 h.p. of Niagara power, and the Commission has already started to avail itself of the entire amount contracted for, an order for the last 10,000 h.p. having been made this year. The increase of power loads of municipalities using Niagara power has been enormous since October, 1910, the consumption increasing rapidly to over 38,000 h.p. daily during the month of December, 1912; over 48,000 h.p in December, 1913, and over 70,000 h.p. in December, 1914. The figures just issued by Sir Adam indicate that there has been no falling off in the rate of increase, the general industrial depression notwithstanding.

MONT D'OR TUNNEL COMPLETED.

A new railway link between France, Switzerland and Italy—the Frasne-Vallorbe Railway, including the Mont d'Or tunnel through the Jura—was opened for traffic on Sunday, May 15, without any ceremony, the only railway officers present on the occasion being those of the Paris-Lyons-Mediterranean Company and the Swiss Federal Railways. Work was begun in September, 1910, and was expected to be completed in May, 1914, but was seriously delayed mainly by water-bursts in the tunnel, and also by the difficulty of obtaining a solid foundation for the embankment near Frasne. The original estimate for line and tunnel was $7,400,000, but the actual cost was about $6,437,250 a mile. The new line is about 15 miles in length, 13½ miles of which is in France and 1½ miles in Switzerland. It branches off from the Dijon-Pontarlier line at Frasne, and penetrates the Mont d'Or by a tunnel 6,670 yards long, joining the Pontarlier-Lausanne line at Vallorbe. By avoiding the circuitous route via Pontarlier the new line shortens the distance between Paris and Lausanne by nearly 10 miles, while other improvements have resulted in a gain of from 45 to 60 minutes in the journey between the same points, with a consequent quickening of the Paris-Simplon-Milan service. The curves of the new line are favorable for speed, and, in winter, the tunnels and pine forests are a protection against snowstorms. Vallorbe has become a customs station, and has been entirely remodeled, so that trains can now enter and leave without the engines having to be uncoupled and reversed.

PERSONAL

PETER COWAN succeeds S. Bartleman as waterworks superintendent for the city of Galt, Ont.

Sergt. C. B. FERRIS, 2nd Field Company, Canadian Engineers, First Canadian Contingent, was seriously wounded last week while fighting in France.

ALEX. BAIRD has resigned from the membership of the Galt (Ont.) Waterworks Commission to devote his entire time to the management of the Hespeler branch of the Canadian Machinery Corporation.

F. LESLIE BRINKMAN has been appointed assistant resident engineer in the Department of Public Works at Fort William, Ont. Formerly Mr. Brinkman was assistant engineer for the city of St. Thomas, Ont.

MAXIMILIAN GROTEN, chief mechanical engineer for the Russian Imperial Railways, Petrograd, is in Canada and the United States placing orders for steel-framed box cars, 2,000 of which have been ordered from the Eastern Car Co., of New Glasgow, N.S.

Lieut. ELLIOTT GREENE, of the 9th (Toronto) Battery, Canadian Artillery, a graduate in mechanical engineering of the University of Toronto, and assistant superintendent of the Peterborough Water and Light System until he enlisted for active service last August, has been mentioned in recent despatches for distinguished service.

Lieut. H. F. H. HERTZBERG, of the 2nd Field Company, Canadian Engineers, is one of those recently mentioned in despatches from the front, and has received the Military Cross. Lieut. Hertzberg was wounded at Langemarke and removed to Colchester Hospital, England. According to recent letters received by his friends he is rejoining the Engineers at the front this week. Before enlisting Lieut. Hertzberg was chief engineer of the Trussed Concrete Steel Company of Canada, Limited, Walkerville, Ont.

DREDGING AND COMPENSATING WORKS NEAR MONTREAL.

The Department of Marine and Fisheries, Ottawa, is constructing compensating works near Lake St. Peter to raise water levels in the St. Lawrence. This is a carrying out of the recommendations of Prof. E. E. Haskell as chairman of the commission which investigated the conditions of water levels between the lake and Montreal. Simultaneously with this work will proceed that of dredging the ship channel to a depth of 35 feet. This dredging will be completed this season, but the balance of the work will involve several years' operations, as there are some 50 miles of further dredging to be done. The most difficult part of the operations will be dredging at Cap a la Roche, where the channel will have to be deepened through the solid rock.

The compensating works recommended to be built comprise the erection of a dyke opposite Pointe du Lac, to be about 4,800 feet long, the closing of five channels through the group of islands at the head of Lake St. Peter, and the construction of a dyke some 3,500 feet long, between Isle a Bague and Isle Bellegarde. The estimated cost of the work is $487,341.

OBITUARY.

Mr. William Beam, an electrician in the employ of the Windsor Hydro-Electric System, met death on June 23rd by coming into contact with a high-voltage wire.

The death occurred near Huntingdon, B.C., of Jesse F. McGoon, electrical engineer in charge of the Veddar River station of the British Columbia Electric Railway Company.

BRITISH COLUMBIA LAND SURVEYORS.

The list of land surveyors authorized to practise in British Columbia has been increased by the addition of the following names, Messrs. A. S. B. Jones and J. A. Rutherford, Victoria; Messrs. E. C. W. Lamarque and W. J. Moffatt, Vancouver, and Mr. A. J. Todd, Kerrisdale.

INTERNATIONAL ENGINEERING CONGRESS.

The excursions to points of engineering interest around San Francisco, Cal., form a very interesting part of the programme of the International Engineering Congress, Sept. 16-25. They are listed as follows:—

The San Francisco High-Pressure Fire System; The Potrero Gas Works and Electric Station "A," Pacific Gas and Electric Co.; Spring Valley Waterworks Properties on east side of San Francisco Bay; Spring Valley Waterworks Storage Reservoirs and Pumping Stations, located on the San Francisco Peninsula; The Delta Lands of the Sacramento and San Joaquin Rivers; Great Western Power Company's Hydro-electric Development on the Feather River and Dredging at Oroville; Pacific Gas and Electric Company's Hydro-electric Development at Lake Spaulding and Drum Power-House and the Gold Mines at Grass Valley; Oil Fields at Coalinga.

COMING MEETINGS.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Annual convention to be held in San Francisco, Cal., September 16th to 18th, 1915. Secretary, Charles Warren Hunt, 220 West 57th Street, New York.

INTERNATIONAL ENGINEERING CONGRESS.—To be held in San Francisco, Cal., September 20th to 25th, 1915. Secretary, W. A. Catell, Foxcroft Building, San Francisco, Cal.

AMERICAN ELECTRIC RAILWAY ASSOCIATION.—Annual convention to be held in San Francisco, Cal., October 4th to 8th, 1915. Secretary, E. B. Burritt, 29 West 39th Street, New York.

The Ottawa Board of Control has strongly recommended the appointment of a commissioner of works, to have charge of street pavements and waterworks.

The John Bertram and Sons Company, Limited, and its associate company, Pratt and Whitney Co. of Canada, Limited, announce change of western offices address to 1205 McArthur Building, Winnipeg. Mr. A. Martin is the western representative.

ORDERS OF THE RAILWAY COMMISSIONERS

The following orders have been passed by the Board of Railway Commissioners of Canada. Copies of any of these orders may be secured from The Canadian Engineer, 62 Church Street, Toronto, upon payment of a small fee.

23791—June 2—Granting leave to C.N.O.R. pending further Order, to remove regular agent at Solina Station, Ont., subject to and upon condition that caretaker be appointed to meet passenger trains and keep station clean and heated, and see that L.C.L. freight and express matter is properly housed.

23792—June 2—Authorizing Toronto Suburban and G.T.R. Cos. to operate their cars and trains over crossing on The Acton Tanning Co.'s property at Acton, Tp. Esquesing, Co. Halton, Ont., without their first being brought to a stop.

General Order, No. 145—May 31—Directing that C.P.R., by 1st day of July, 1915, equip its engines with a locking gear for dampers of ash pans: Provided that no engine be operated from and after that date unless so equipped.

23793—June 4—Authorizing C.N.R. to open for traffic from mileage 30 to Gravelbourg, Sask., until October 30th, 1915: Provided speed of trains operated over said portion be limited to rate not exceeding fifteen miles an hour.

23794—June 5—Approving revised location Edmonton, Dunvegan and B.C. Ry. Co.'s line through Secs. 1 and 12-62-27, W. 4 M., M. 66.

23795—June 5—Directing that, within 60 days from date of this Order, C.P.R. install improved type of automatic bell at crossing of highway at mileage 6.94, at Ketepec Station, parish of Lancaster, Co. St. John, N.B.; 20 per cent. of cost of installing bell be paid out of The Ry. Grade Crossing Fund, remainder by C.P.R.

23796—June 7—Extending, until July 1st, 1915, time within which C.P.R. install bell at crossing of highway at Martinon Station, New Brunswick.

23797—June 7—Relieving C.P.R. from providing further protection at crossing of highway at mileage 114, Algoma Sub. Div., Ont.

23798—June 7—Rescinding Order No. 22432, dated August 24th, 1914.

23799—June 7—Extending, until July 1st, 1915, time within which C.P.R. install bell at main highway between Ketepec and Acamac, New Brunswick.

23800—June 4—Relieving Erie and Ont. Ry., and M.C.R.R. Cos., from maintaining night signalman to operate interlocking plant at crossing at mileage Erie and Ont. Branch 9.46 and M.C.R. 30.5, Tp. Moulton, Co. Haldimand, Ont., near Attercliffe; home signals and derails on M.C.R. be set "clear," and all signals and derails on Erie and Ont. at "stop," between 8 p.m. and 7 a.m.; key of tower be left in custody of day signalman. Amending Order No. 23004, dated Dec. 19th, 1914, by striking out word "operators" in first line of sub-section (a) of clause 2 of Order and substituting word "watchmen."

23801—June 7—Directing C.N.R. to erect, within 30 days from date of this Order, a one-pen stock yard at Mitchelton, Sask.

23802—June 4—23803—June 5—Granting leave, pending further Order, to C.N.O.R., to remove regular agents at Actinolite, Ont., and Camden East Station, Ont., subject to condition that caretakers be appointed to see that station is kept clean and heated for accommodation of passengers on arrival and departure of trains, and look after express and freight matter.

23804—June 4—Granting leave, pending further Order, to C.N.O.R. to remove regular agent at Ormsby Junction, Ontario.

23805—June 8—Amending Order No. 23766, dated May 28th, 1915, by striking out word "north-westerly" in fifth line of operative part of Order and substituting word "north-easterly."

23806—June 8—Authorizing C.P.R. to construct two main line tracks, at grade, across certain road allowances between mileage 2.01 and 12.28, Moose Jaw Subdivision, Sask. Div.; and one additional track across certain road allowances between mileages 12.32 and 15.38, Moose Jaw Subdivision, Sask. Div.; and rescinding Order No. 19804, dated July 17th, 1913.

23807—June 8—Authorizing G.T.R. to reconstruct bridge carrying public highway on Lot 21, Con. 2 of Tp. Bosanquet, commonly known as Ridge Road and being first road east of Thedford Station, over 15th Dist., Stratford Division, mileage 136.25.

23808—June 7—Authorizing C.P.R. to construct across Government Trail at mileage 59.31 (Red Deer to Rocky Mountain House), in Sec. 14-39-7, W. 5 M., Alta.

23809—June 7—Authorizing C.N.R. to carry traffic over its line of railway between Grand Marais and Birds Hill, Man., a distance of 50 miles, until October 30th, 1915.

23810—June 9—Dispensing with publication in The Canada Gazette of notice of application, of Kettle Valley Ry., under Sec. 364, for approval of agreement, entered into the 10th day of July, 1914, between V.V. and E. Ry. and Nav. Co. and Applicant, and approval of shareholders required under Railway Act. 2. Recommending to Governor in Council for sanction the said agreement, a duplicate original of which is hereto attached marked "A."

23811—June 2—Dismissing application City of Vancouver for approval of plans of crossing over C.P.R. at Rupert St., Vancouver.

23812—June 1—Dismissing application of John, Jas. W., and Hannah Milsted of Abbotsford, B.C., for Order directing G.N.R. to remove obstructions closing road across easterly boundary of Lot 8, Subdivision of S.E. ¼ Sec. 22-16, New Westminster Dist., B.C.

23813—June 2—Dismissing complaint Grain Growers' Lumber Co., of Vancouver, B.C., that under Note 2 of Sup. No. 45 to C.R.C. No. 1806, C.P.R. exacts higher weight basis on mixed carloads lumber and shingles to points in Western Canada than to points in Eastern Canada under C.R.C. No. W. 1615, and Transcontinental Tariff C.R.C. No. 1790.

23814—June 1—Dismissing application Municipalities of New Westminster, Burnaby and Coquitlam for Order relieving them from further payment on account of wages of watchman referred to in paragraph 3 of Order No. 11734, Sept. 6, 1910.

23815—June 9—Authorizing T.H. and B. and G.T.R. Cos., to construct spur from point short distance west of Sherman Ave., on spur jointly owned by Applicant Cos., running southerly and easterly through lands of Board Public Parks Management of city of Hamilton, Corporation of city of Hamilton, and the Canadian Cartridge Co., Ltd. To be completed within three months from date of this Order.

23816—June 9—Authorizing Lake Erie and Northern Ry. to construct, at grade, its ballast pit spur, in Tp. Townsend, Co. Norfolk, Ont., across Given Road.

23817—June 9—Authorizing C.P.R. to reconstruct Bridge No. 3.4 on Drummondville Subdivision, Eastern Div., over Chapman Brook.

23818—June 9—Relieving C.P.R. and C.N.R.R. from maintaining night signalman at crossing at Central Ontario Jct., Ont.; during night hours signals on C.N.O.R. and diamond signal, be set against C.N.O.R., and diamond signal governing C.P.R. track be set at clear; key of station remain in possession of joint agent.

23819—June 9—Approving Agreement between Bell Telephone Co. and The Municipal Corporation Tp. Tuckersmith, operating in Province of Ont., dated May 31st, 1915.

23820—June 9—Authorizing C.P.R. to operate bridge over St. Maurice River, Eastern Division, 3rd Dist., Cap de la Madeleine Ry.

23821—June 9—Directing that, within 60 days from date of this Order G.T.R. install automatic bell at crossing of

Parkdale Ave., Ottawa, Ont., and thereafter maintain bell at own expense; 20 per cent. of cost of installing bell be paid out of Ry. Grade Crossing Fund, remainder by Railway Company.

23822—June 9—Authorizing, pending further Order, C.N.O.R. to remove agent at Perth Road Station, Ont., subject to condition station is kept clean and heated for accommodation of passengers on arrival and departure of trains, and that L.C.L. freight and express matter is looked after.

23823—June 15—Directing that crossing of Ontario St., Cobourg, be protected by watchman between 7 a.m. and 8 p.m.; wages of watchman be paid ⅓ by C.L.O. and W. Ry. (C.P.R.) and ⅔ by G.T.R.

23824—June 10—Authorizing G.T.R. to construct siding, commencing at point on Ottawa Div., and on Lot No. 16, Con. 11, Tp. McMurrich east of Sprucedale Station, extending in westerly direction into premises of M. and M. A. Deans.

23825—June 12—23826—June 12—Authorizing C. N. Alta. Ry. to construct bridge across Miette River, S.W. ¼ Sec. 7-45-1, W. 6 M., mileage 237.2, Alta.; also across Snaring River, Sec. 33-46-1, W. 6 M., M. 223.

23827—June 11—Authorizing Bell Telephone Co. to construct its line of telephone on north side of Elizabeth St., between Queen and Manly Sts., town of Midland, Ont.

23828—June 12—Authorizing Lachine, Jacques-Cartier and Maisonneuve Ry. to construct across Faber and Everett Sts., Champlain and Papineau Aves., Hughes St., Shaw and Rossland Aves., and Belanger St., city of Montreal, Que.

23829—June 12—Relieving C.P.R. and M.C.R. Cos., from maintaining a night signalman to operate interlocking plant at crossing at Appin, Ont.; home signals and derails on C.P.R. be set "clear," and all signals and derails on M.C.R. be set "stop"; key of tower be left in custody of day signalman.

23830 to 23834 (Inc.)—June 14—Authorizing C.P.R. to operate following bridges:—No. 22.3, Toronto Subdivision, Ont. Div., near Peterborough Station, Ont.; No. 21.8, near Botulf Station, Ont.; No. 3.2, near Elmsley Station, Ont.; No. 29.0 between Maberly and Ungava Station, Havelock Subdivision, Ont. Division; and No. 13.4, near Perth Station, Ont., Havelock Subdivision.

23835—June 14—Authorizing C.P.R. to reconstruct bridge No. 81.5, on Schreiber Subdivision, Lake Superior Div., Ont.

23836—June 14—Extending, for period, of three (3) months from July 1st, 1915, time within which C.N.R. complete alterations and additions to its station building at Alsask, Sask.

23837—June 14—Authorizing C.P.R. to operate bridge over highway between Lots 5 and 6, Con. 5, Tp. Toronto, London Subdivision, Ontario Division, Ont.

23838—June 14—Authorizing town of Swan River, Man., at own expense, to construct highway crossing over C.N.R., at Main St.

23839 to 23842 (Inc.)—June 14—Authorizing C.P.R. to operate following bridges:—No. 33.5, near Cavan Station, Ont.; No. 4.9, near Norwood Station, Ont.; No. 0.7, near Havelock Station, Ont.; and No. 7.1, near Norwood Station, Ontario.

23843—June 15—Approving revised location Montreal and Southern Counties Ry. Co.'s line from boundary line between parishes St. Cesaire and St. Paul d'Abbotsford, Co. Rouville, Que., easterly through ranges of Papineau, St. Joseph, and Dwyer, to Lot 177, Range of Dwyer, all in parish St. Paul d'Abbotsford; and authorizing construction of said railway along and upon highway known as Jackmann's Road, in vicinity of crossing of C.P.R.

23844—June 15—Authorizing G.T.R. to operate its engines and trains over extension of siding recently constructed by Brantford Cordage Co., Ltd., on its premises in Brantford, Ont., subject to Co.'s keeping employees off sides of cars while operating over siding and extension, and approving and authorizing clearances as shown on plan.

23845—May 1—Extending, for period of six months from date of this Order, time within which G.T.R. complete sidings it was authorized to construct by Order No. 22818, dated October 30th, 1914, into premises of Ford Motor Co. of Canada, Ltd., Tp. Sandwich East, Co. Essex, Ont. (near Walkerville).

23846 and 23847—June 15—Authorizing C.P.R. to operate bridge No. 19.2 on Red Deer Subdivision; and bridge No. 117.6, on its Laggan Subdivision, Western Division.

23848—June 15—Authorizing G.T.R. to reconstruct bridge carrying public highway known as Saltford Road, town of Goderich, over 20th Dist., London Div., mileage 162.13.

23849—June 15—Authorizing Kettle Valley Ry. Co., to construct across and divert highway at mileage 69.17, and to cross highway at mileage 70.09, west of Penticton, B.C.

23850—June 15—Authorizing C.P.R. to operate bridge No. 18.1, on its Shuswap Subdivision, British Columbia Division.

23851—June 14—Authorizing C.N.R. to construct spur to serve the Rosedale Coal and Clay Products Co., Ltd., in Secs. 29 and 28-28-19, W. 4 M.; and to cross North and South road allowance between Secs. 29 and 28-28-19, W. 4 M.

23852—June 14—Relieving G.T.R. from providing further protection at crossing 1¼ miles west of Brantford, Ont., known as Toll Gate Crossing.

23853—June 15—Authorizing C.P.R. to operate Bridge No. 27.3, on its McLeod Subdivision.

23854—June 14—Approving agreement between Bell Telephone Co. and Municipal Cor. Tp. Otonabee, dated June 1st, 1915.

23855—June 15—Authorizing C.P.R. to construct industrial spur for Kennedy Construction Co., Ltd., in Lots 94 and 95, parish of St. Francois de Sales, Co. Laval, Que., mileage 8.32.

23856—June 14—Authorizing Lachine, Jacques-Cartier and Maisonneuve Ry. to divert certain lanes in city of Montreal, Que.

23857—June 14—Authorizing Minister of Roads of Province of Que., at own expense, to construct and maintain highway crossing over C.N. Que. Ry. on Lot 17, parish of St. Joseph-de-Des-Chambeault, Co. Portneuf, Que.

23858—May 27—Directing that C.N.R. change time-card of Elrose Subdivision, so that train which now leaves Macrorie Jct., for Elrose on Thursday shall leave on Friday, and that train which now leaves Elrose for Macrorie Jct., on Friday shall leave on Saturday.

23859—June 16—Refusing application of John P. Shultz, of Dalmeny, Sask., for Order directing C.N.R. to construct siding between Dalmeny and Mannon, Sask.

23860—June 16—Approving form of Special Contract, or Release of Responsibility, in connection with transportation of perishable freight in cold or stormy weather, filed by C.P.R.

23861—June 15—Approving Moncton and Buctouche Ry. Co.'s Standard Frt. Mileage Tariff, C.R.C. No. 21; Tariff, with copy of this Order, be published in at least two consecutive weekly issues of The Canada Gazette.

23862—June 15—Approving agreement between Bell Telephone Co. and the Farrelton Rural Telephone Co., Ltd., dated May 28th, 1915.

23863—June 15—Relieving Central Vermont Ry. from providing further protection at crossing of highway first north of St. Armand Depot, Que., subject to condition that speed limitation of 10 miles an hour over crossing be maintained.

23864—June 15—Amending Order No. 23800, dated June 4th, 1915, by striking out clause 1 of operative part of Order and substituting therefor that companies be relieved from maintaining watchman to operate crossing on Sundays and between 8 p.m. and 7 a.m. on week days, so long as character of movements over crossing shown to exist continues, and provided home signals and derails on M.C.R. be set "clear," and all signals and derails on Erie and Ont. Ry. at "stop"; and key of tower be left in custody of day signalman.

23865—June 2—Directing that G.N.R., within three months from date of this Order, install and maintain improved type of illuminated electric bell at crossing of highway east of White Rock Station, B.C. Dept. Public Works pay to Ry. Co. the cost of installing and maintaining bell.

23866—June 17—Approving agreement between Bell Telephone Co. and Municipal Corporation, Tp. Moore, dated June 4th, 1915.

23867—June 18—Authorizing Dept. Public Works for Alta., to construct and divert highway crossing over Alberta Central Ry. in S.W. ¼ Sec. 15-39-3, W. 5 M., Alberta.

(For further Railway Orders see Page 58.)

ONE MILLION WEEKLY FOR SHELL MAKING

Sixty thousand artisans are employed in Canada, drawing weekly wages of $1,000,000 in 247 factories, manufacturing shells for the war arena. Orders for 9,000,000 shells have been placed here by the shell committee and for 8,100,000 cartridge cases, fuses, primers, and friction tubes. For these contracts orders have been placed for 170,000 tons of steel, 30,000 tons of lead and several thousand tons of other material. Canada will be shortly turning out 50,000 shells per day.

These facts were given by Colonel Alexander Bertram, chairman of the shell committee appointed by the Dominion Government to superintend the manufacture of munitions of war, in an address to the delegates to the Canadian Manufacturers' Association convention at Toronto last week. Colonel Bertram said:—

"Shortly after the war broke out the minister of militia received an order from the British Government for supplies of arms and ammunition. Contracts were placed for these both in Canada and the United States, and then came the request for 200,000 shrapnel shells, unloaded, in equal numbers of 15 and 18-pounders. Canada possesses in the city of Quebec a modern plant for the manufacture of shells, but its capacity is limited. It can only produce 75 shells per day, which we now see was quite inadequate to meet the demand. There was only one thing to do. The minister of militia conceived the idea of utilizing the engineering factories throughout the Dominion for shell manufacture, and to secure the co-operation of employers and employes in the engineering trades to take up this patriotic work.

"A committee was appointed to organize the movement throughout the Dominion. The members of this committee are: Messrs. Thos. Cantley, of New Glasgow; George W. Watts, Toronto; E. Carnegie, Welland; General T. Benson, master general of ordnance; Mr. J. W. Borden, chief accountant and paymaster-general; Col. Harston, and Col. Lafferty, the latter four representing the Department of Militia and Defence. I had the honor to be named chairman.

"As a direct outcome of the work of the shell committee a copper refinery in Canada will be made possible. Our experience in nine months has demonstrated the fact that the development of this industry in the Dominion, while it would undoubtedly benefit every manufacturer who uses copper, is above all things a military necessity. Canada will not have to remain long under the reproach of having to import its refined copper, and I can assure you of this, that within three or four months we expect to be making in this country, from the native product, all the copper bands required in the production of shells.

"It was agreed to supply all the component parts of shells free of charge to those manufacturers who would undertake the work of finishing and assembling the complete shells. In this way many of the smaller manufacturers were relieved of the financial burden of carrying a heavy stock of the raw materials, and which very largely contributed to the success of this huge undertaking. It was further decided to eliminate unhealthy competition by paying uniform price for the same article. An inspection company was chosen to deal with all shell components, thus relieving the assembling manufacturers of the responsibility of inspection, while at the same time satisfying the shell committee beyond question that the component parts of shells were correct in every particular before the finished article passed into the hands of the Government inspector.

"Starting with the first order for 200,000 shrapnel we have since placed orders aggregating 9,000,000 shells consisting of 15 and 18-pounder shrapnel; 18-pounder, 4.5 and 60-pounder high explosive shells. In addition we have placed orders for 100,000 cartridge cases, 5,000,000 fuses, 2,000,000 primers, and 1,000,000 friction tubes.

In no one single establishment in Canada except the Dominion Arsenal at Quebec, is the complete shell made. One hundred and thirty firms from Halifax to Vancouver are engaged in the work of machining and assembling. Others are occupied in the manufacture of blanks, bullets, discs, cartridge cases, buckshot, primers, tubes, tin cups for shrap-

nel, grub screws, sockets, and plugs, steel base plates, and boxes. From an enumeration of these various articles it will be observed how extensive the several operations are.

"At the present time no less than 247 factories are engaged in this work in 78 cities and towns in the Dominion. In Montreal alone 35 factories are employed. Toronto has 28, Hamilton 17, and so on throughout the Dominion from coast to coast. Practically every province of Canada is participating in this enterprise. The manufacture of shells in this country is giving employment to between 60,000 and 70,000 artisans while the total weekly wage bill easily amounts to $1,000,000. From these figures you will see what the shell-making industry means to the working men as well as to the manufacturers of the Dominion.

"The changes which were necessary in the equipment of the various factories by adding new machinery, or in the readjustment of existing plants, were made by the manufacturers themselves and at their own expense. These changes gave employment to many other factories which were not directly engaged in making ammunition. In the course of a very short time now we shall be producing from between 40,000 and 50,000 shells per day. For the contracts already placed it may interest you to know that 170,000 tons of steel, about 30,000 tons of lead, and several thousand tons of other materials are required.

"In addition to the manufacture of several thousand tons of cordite and powder in connection with the present contract, an important new industry has been initiated in the Dominion, viz., the utilization of the by-products from the coke ovens of the Dominion Iron and Steel Company at Sydney, N.S., for the manufacture of the high explosive, trinito-toluene. The revenue alone from the contract placed with this company will be nearly $5,000,000."

France received 15,344,550 metric tons of coal in 1914 from other countries, over 60 per cent. of which came from England.

CANADIAN MILLS INCREASE PRODUCTION

The consumption of pulpwood in Canada increased nearly ten and a half per cent. in 1914, as compared with 1913. Since 1910 the increase has been one hundred and four per cent. The sixty-six active pulp mills in Canada in 1914 consumed 1,224,376 cords of pulpwood valued at $8,089,868; while, in addition to this, 972,508 cords valued at $6,680,490 were exported in an unmanufactured state. The proportion of pulpwood made into pulp in Canada to that exported in the raw state is increasing, thus giving more employment in Canadian mills. In 1914, 55.7 per cent. of all pulpwood produced in Canada was made into pulp in Canada and 44.3 per cent. was exported, chiefly to the United States, in the raw or cordwood state. A few years ago only one-third of the pulpwood produced in Canada was made into pulp here.

The proportion of pulp made by the chemical processes is increasing as compared with pulp produced by the groundwood process. This is gratifying because the pulp thus produced is worth about two-and-a-half times as much as groundwood pulp. The chemical processes also permit a wider range in the selection of timber for pulping purposes, an important factor in bringing into use as many as possible of our native Canadian trees.

The above and many other facts about pulpwood and woodpulp production in Canada, are contained in the Bulletin "Forest Products of Canada, 1914: Pulpwood," which has been compiled by the Forestry Branch of the Department of the Interior, and which has been sent to the printer for issue as soon as possible. Copies of the bulletin may be had free upon its completion and those interested in the pulp and paper industry who desire, in the meantime, information upon any particular point will receive the same by writing to the Director of Forestry, Department of the Interior, Ottawa.

A steel railway bridge, on concrete piers, has been completed over the Avon River, in Nova Scotia, on the Dominion Atlantic Railway, which is controlled by the C.P.R.

TENDERS CALLED FOR

TENDERS FOR SUPPLIES.

Tenders will be received through registered post only up to noon on Tuesday, July 6th, 1915, for the supply of:—

55-A—Two Portable Crossovers, Right and Left-Hand Turnouts, and No. 60 Rail.

64—One Steam Pump, complete, for Hydraulic Operation of Gate Valves, High Level Pumping Station.

65—Air Compressor, with Motor, Danforth Avenue Car Barns.

Tenders must be addressed to the Chairman, Board of Control, City Hall, Toronto, and envelopes must be plainly marked on the outside as to contents. Specifications and forms of tender may be obtained at the Works Department, City Hall. Tenderers must comply strictly with conditions of City By-law as to deposits and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH (Mayor),
Chairman, Board of Control.
Toronto, June 22nd, 1915.

TENDER FOR BUILDING A WATER SUPPLY AND SEWERAGE FOR THE TOWN OF BATHURST, N.B.

Sealed tenders for the construction of Water Supply and Sewerage Systems complete with Dam, Power House, Boiler House, Piping, Pumping Station, etc., also outlet work, Water Mains, Sewer Piping, Manholes, 405,000 gallons Steel Stand Pipe; all other appurtenances, will be received by the Town of Bathurst, New Brunswick, at the Town Hall, until eight o'clock p.m., on the Tenth Day of July, 1915.

Each tender must be accompanied by a marked cheque payable to the Town of Bathurst, to an amount equal to 5 per cent. of the tender, as a guarantee that the contractor will enter into the contract if awarded.

The Cheques from all the unsuccessful tenderers will be returned to their respective makers within fifteen days from date opened, or earlier, if contract be awarded.

The cheque of the contractor to whom the award is made will be held until the contract is signed and will then be returned to the maker, but in lieu thereof contractor will be required to furnish a collateral or other satisfactory bond to an amount of 50 per cent. of the contract price for the successful performance of the contract, in accordance with the plans and specifications. The proceeds of the cheque will become the property of the Town of Bathurst, if for any reason whatsoever the tenderer withdraws from the competition after the opening of the tenders, or refuses to execute the required contract and bond if his tender is accepted.

All Tenderers are invited to be present at the opening of the tenders.

Plans and specifications are on file at the office of the Town Clerk, Bathurst, N.B., where same may be seen.

The Town of Bathurst reserves the right to reject any and all bids.

By order of Water and Sewerage Committee,

F. O. LANDRY,
AZADE LANDRY,
W. J. KENT.

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TENDERS FOR FOUNDATIONS.

Tenders will be received by registered post only up to noon Tuesday, July 6th, 1915, for constructing foundations for incinerating plant on Don Roadway.

Tenders must be addressed to the Chairman, Board of Control, City Hall, and be plainly marked on outside of envelopes, "Tender for Foundations, Refuse Incinerating Plant." Specifications and form of tender may be obtained at Street Commissioner's Office. Parties tendering must comply strictly with conditions of City By-law as to deposit and sureties, as set out in specifications and forms of tender. The lowest or any tender not necessarily accepted.

T. L. CHURCH (Mayor),
Chairman, Board of Control.

TENDERS FOR CONCRETE RESERVOIR

Tenders will be received by the Water Commissioners of the City of Guelph, until noon Tuesday, July 6th, for the construction of a reinforced concrete reservoir. Specifications and forms of tender may be had by applying to the Water Commissioners' office.

The lowest or any tender not necessarily accepted.

(Signed), Guelph Water Commissioners,
A. H. FOSTER, Manager.

Guelph, Ont., June 22nd, 1915.

TENDER FOR THE LAYING OF CONDUIT LINE

Tenders for the laying of approximately fifty-five hundred feet (5,500 ft.) of Conduit Line will be accepted by the Water Commissioners of the City of Guelph, until noon, Tuesday, July 6th.

Specifications and form of tender may be had by applying at the Water Commissioners Office, at the City Hall.

The lowest or any tender not necessarily accepted.

(Signed), Guelph Water Commissioners,
A. H. FOSTER, Manager.

Guelph, Ont., June 22nd, 1915.

(For further Tenders see Page 56.)

NEW TELEPHONE LINES IN SASKATCHEWAN.

The 1914 report of the chief engineer of the Department of Telephones of Saskatchewan, gives the following mileage of entirely new toll lines:—

New toll lines.	Pole miles.	Wire miles.
Forward to Ogema	27.2	58
Gull Lake to Alberta Boundary	83.4	182
Nokomis to Semans	15	40
Estevan to Lampman	17	58
Lumsden to Watrous	92	212
Total	234.6	550

ORDERS OF THE RAILWAY COMMISSIONERS OF ONTARIO.

(Continued from Page 124.)

23868—June 18—Approving and authorizing, for period of three months from date of this Order, clearances between G.T.R. and telegraph poles carrying wires of G.N.W. Tel. Co., and railway wires between Guy St. and St. Henri Station, Montreal, P.Q.

23869—June 18—Authorizing C.P.R. to use and operate interlocking plant installed at swing bridge over Lachine Canal, at mileage 43.1 on its Farnham Subdivision.

23870—June 19—Authorizing C.N.Q.R. to construct trestle bridge over Shawinigan River, Que., on revised location at mileage 86.69 from Quebec.

23871—June 18—Approving specifications and detail plans of C.P.R. Standard Steel Spans. Rescinding Order No. 5658, dated November 21st, 1908.

23872—June 18—Authorizing C.P.R. at own expense, to construct Heink St., Townsite Enchant, Alta., across its Suffield Sub. Div.; and to construct road diversion A.D., in S.E. ¼ Sec. 17-14-18, W. 4 M.

23873—June 18—Authorizing C.P.R. to construct proposed siding extension, at grade, across Front St., town of Grand Falls, N.B., at mileage 18.69, Edmundston Sub. Div.

23874—June 18—Authorizing C.P.R. to reconstruct bridge No. 2.5 over Jackson River, Drummondville Sub. Div., Eastern Division.

23875—June 18—Approving agreement between Bell Telephone Co. and Mun. Cor., Tp. McKillop, dated June 8th, 1915, and rescinding Order No. 11844, dated September 30th, 1910.

23876—June 19—Authorizing G.T.R. to construct siding, for accommodation of Laurin & Leitch, St. Johns, Que., into premises of Dept. Railways & Canals, subject to certain conditions.

23877—June 19—Refusing application Wm. Holmes Brown, Quebec, Que., for Order directing Quebec & Lake St. John Ry. to sell ten-trip series of tickets from Quebec to St. Catharines Station, at rate of 40c. each.

23878—June 18—Authorizing C.N.R. to construct highway over its railway north of Sec. 27-46-23, W. 2 M., Sask.

23879—June 21—Approving plans and specifications of Tp. Dunwich., Ont., showing character of work proposed in connection with a drain to be constructed under M.C.R. and Pere Marquette Railroad Cos., in Tp. Dunwich, Co. Elgin, Ontario.

23880—June 21—Authorizing G.T.R. to construct and operate certain railway sidings for Toronto-Hamilton Highway Commission, near Oakville, Ont.

23881—June 22—Directing that, within six months from date of this Order, V. V. & E. Ry. & Nav. Co. submit for approval of Board detail plans showing proposed new location of station and facilities to be constructed in Vancouver, B.C., work to be completed by June 1st, 1917.

23882—June 21—Authorizing C.P.R. to use bridge No. 37.5, on Havelock Sub. Div., Ont.; and rescinding Order No. 23839, dated June 14th, 1915.

23883—June 21—Granting leave to C.P.R. to terminate agreement, under which siding was constructed to premises of P. J. Manion and Jas. Murphy, Fort William, Ontario.

23884—June 22—Authorizing C.P.R. to use bridge No. 28.33 over Little Bow River, mileage 28.57, Lethbridge-Aldersyde Branch.

23885—June 21—Directing that V. V. & E. Ry. & Nav. Co.'s line between Ocean Park and White Rock be protected—1 watchman to patrol track between mile posts 123 and 127, from 7 a.m. to 7 p.m.; 1 night watchman between mile posts 123 and 125, from 7 p.m. to 7 a.m.; and 1 night watchman between mile posts 125 and 127, from 7 p.m. to 7 a.m. Rescinding Order No. 17959, dated Nov. 5th, 1912.

23886—June 22—Authorizing city of Vancouver, B.C., to carry out new grade at point beginning at north side Keefer St., to point at south side Cordova St., said city, provided authority herein granted be without prejudice to rights of Applicant under Order No. 17840, October 14th, 1912.

23887—June 21—Authorizing Dept. Public Works for B.C. to construct at own expense, foot bridge over G.T.R. Ry. at McBride St., Prince Rupert, B.C.

23888—June 22—Authorizing Board of Grain Commissioners for Canada, to lay trackage to serve government elevator and docks in Vancouver, B.C.; and rescinding Order No. 22324, dated August 1st, 1914, authorizing city of Vancouver to construct a highway over C.P.R. at Commercial Drive.

23889—June 21—Approving location Lake Erie and Northern Railway Company's proposed yard and station at Simcoe, Tp. Woodhouse, Co. Norfolk, Ontario, provided end of freight siding be constructed north of Victoria St.; Rly. Company be at liberty to apply to Board at any time for extension of siding across Victoria St. when business necessities require it.

23890—June 22—Directing that city of Edmonton, Alta., raise sidewalk approaching C.N.R. tracks on both sides Ottawa Ave., and both sides of tracks, to rail level, and erect railing on each side of sidewalks on north side of tracks; approach of streets on north side of tracks be raised to give easy slope towards track; work be done at expense of city, within one month from date of this Order. Within 3 months from date of this Order, C.N.R. and G.T.P.R. install improved types of automatic bells at crossings of respective railways, 20 per cent. cost installing each bell be paid out Rly. Grade-Crossing Fund, remainder by Railway Companies.

23891—June 22—Directing that C.P.R. provide and erect gates at farm crossing on property of J. F. Huneault of Monte Belle, Que., Lot Cadastral No. 96; work to be completed within 15 days from date of this Order.

NEW INCORPORATIONS.

Vancouver, B.C.—Viking Mining Company, Limited, $45,000.

Ottawa, Ont.—The Pitts Construction Company, Limited, $50,000. H. H. Pitts, G. M. Pitts, C. M. Pitts.

Quebec, Que.—Quebec Engineering Company, Limited, $99,000. C. E. Taschereau, J. P. Cantin, A. Laflamme.

Windsor, Ont.—Vacuum Street Cleaning Machine Company, Limited, $175,000. W. T. Blaney, G. S. Clarke, J. A. Corrick.

Whitby, Ont.—Whitby Brick and Clay Products Company, Limited, $250,000. J. F. MacGregor, T. S. H. Giles, W. C. H. Swinburne.

London, Ont.—The Luitwieler Pumping Engine Company of Canada, Limited, $200,000. S. W. Luitwieler, N. E. McLeod, H. H. Williams.

Toronto, Ont.—Invincible Machine Company, Limited, $100,000. J. Y. Murdock, E. B. Daykin, Nellie Sales; National Graphite, Limited, $60,000. W. A. P. Schorman, W. H. Matthews, J. Latimer; the Faced Brick and Machinery Company, Limited, $100,000. P. E. McMillen, W. G. Sunter, L. R. Whiting.

Montreal, Que.—St. Lawrence Machinery, Limited, $50,000. C. F. Smith, E. E. Cummings, H. J. Trihey; Ideal Gas Company, Incorporated, $125,000. J. A. Oligny, I. I. Auger, A. Busseau; the Walpole Rubber Company of Canada, Limited, $100,000. E. M. McDougall, G. S. Stairs, P. F. Casgrain; North American Magnesite Company, Limited, $200,000. H. N. Chauvin, H. E. Walker, J. McDonald.

Winnipeg, Man.—Calumet-Corbin Mines Company, Limited, $5,000. F. R. Sproule, C. H. Locke, D. A. McIvor; Englehart Flexible Spout Holder Company, Limited, $35,000. I. R. Englehart, L. E. Taylor, H. A. Tubbs; European Sanitary Bath Company, Limited, $40,000. J. Horn, A. Meyerowitz, A. Cohen; the Rock Island Oil Company, Limited, $100,000. E. G. Trick, N. A. McMillan, G. S. Thornton.

From 40 to 90 per cent., or an average of over 60 per cent. of the total cost of treating wood, is chargeable to the preservative alone. In ordinary treatments with coal-tar creosote, it is common practice to inject 5 to 10 pounds of the oil per cubic foot of wood, although toxicity tests indicate that about one-half of a pound will prevent fungous growth; in other words, exclusive of subsequent changes, from 10 to 20 times as much creosote is used per volume of wood as is theoretically required. The possibility of safely reducing this amount, and consequently the cost of treatment, is one of the problems which the Forest Products Laboratory at Madison, Wis., is carefully studying.