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The Canadian Engineer

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THE VANCOUVER ISLAND POWER COMPANY, LIMITED, JORDAN RIVER DEVELOPMENT.

PART I.

Western Canada is growing with such rapidity, particularly the southern coast districts of British Columbia adjacent to the cities of Vancouver and Victoria, that in these communities it has been for some time a serious problem with the public utilities companies to keep pace with the rapidly increasing demand for service.

The British Columbia Electric Railway Company, Limited, owning and operating the traction, lighting, and power systems of Vancouver and Victoria, and territories adjacent thereto, has been for the past five years laboring with this problem. The growth and expansion of the districts which this company is serving have been phenomenal, and the demand for power has been multiplied several times within that period. The capacity of British Columbia Electric Railway Company's plants has been increased constantly, both in steam and water power, and generally in time to anticipate requirements.

As early as 1907 it was realized that material increase in power capacity would be required by the Victoria branch, but that this could be met within a period allowing adequate investigation of the available water power resources on the southern end of Vancouver Island, and the installation of a modern, well equipped hydro-electric power system.

At the time the Jordan River development was actually begun, the British Columbia Electric Railway Company was serving Victoria and adjacent territory with electricity from a steam station in Victoria of 800 kilowatt capacity and a hydro-electric station of 2,000 kilowatt capacity at Goldstream, about ten miles out of the city. The latter plant was operated with surplus water purchased from the Esquimalt Water Company, and could run at full capacity only during a part of the year on account of water shortage.

Mr. Wynn Meredith, then consulting engineer for the British Columbia Electric Railway Company, was authorized to investigate the available power possibilities, and under his direction an exhaustive series of investigations were carried out, which included practically all the sources of water power within a radius of commerciably feasible transmission to the city of Victoria. This preliminary work was continued for upwards of a year, and was accomplished under the most extraordinary difficulties, the investigation in many cases being more properly explorations of an unmapped and practically unknown region, untraversed, except for a narrow fringe of coast line, beyond the occasional visit of trapper or timber cruiser. Pioneer work in the forests of British Columbia can only be properly appreciated by those who have undertaken it. Water powers are abundant, but the wild, rugged and inaccessible character of the country renders it difficult in the extreme to acquire even very limited preliminary knowledge of a possible water power development. Most of the virgin country is covered with heavy timber, sometimes cruising 600,000 feet, board measure, per acre; and whether timbered or not the ground is covered with a dense growth of brush and fallen and rotting trees.

The Jordan River Development, Bear Creek Dam.

The hardships endured by the engineers on reconnoissance work, their heart-breaking conquest of the jungles, struggling with pack on back through the proverbial "impenetrable" British Columbia forest, blazing many paths in order to insure safe retreat in case further advance was impossible, or to retrace the course if promising conditions were discovered, have become a part of the history of the "job," and to the preserverance and hardihood of these pioneers the successful culmination of the investigation is largely due.

An examination of the upper watershed of the Koksilah River in the latter part of 1907 led to the first consideration of a possible power development on the Jordan River, the head waters of which lie adjacent to, and only separated by a few hundred yards from the source of the Koksilah. A visit to the mouth of the Jordan on the west coast of the island, a few weeks later, disclosed a large and rapid stream, further exploration of which was prevented at the time by the absence of trails and prevailing wet season, which renders pioneer work in this country almost impossible. A gauging station was, however, established near the mouth of the stream, and a series of observations of run-off instituted.

Early in the spring of 1908, a party of engineers was engaged to explore thoroughly the river and all its branches, investigate the possible reservoir sites, and ascertain in a preliminary way the head or fall obtainable.

This information was gathered during the summer, and in November, 1908, Mr. Meredith, who had in the meantime entered the firm of Sanderson & Porter, engineers, of New York, then made a formal report on the project, having determined that the watershed with the run-off observed, and the use of certain storage reservoirs which had been discovered would, with the head available, amply warrant development for power purposes. Sanderson and Porter were then retained as engineers for the British Columbia Electric Railway Company, Limited, to design and construct the Jordan River power development.

A subsidiary corporation, known as the Vancouver Island Power Company, Limited, was formed under the auspices of the British Columbia Electric Railway Company to finance and otherwise assume charge of the project.

The Jordan River flows into the Straits of Juan de Fuca at a point about 40 miles west of the city of Victoria. It is one of the large streams on Vancouver Island, the drainage area being about 75 square miles, the greater part of which lies above an elevation of 1,200 feet. The source of the main river is at Jordan Meadows, which lies about midway between the east and west coasts of the island at an elevation about 1,700 above sea-level.

Three large tributary streams join the main river in the upper 10 miles of its course, Bear Creek and Alligator Creek from the east, and "Y" Creek from the west, forming a high level watershed, the entire run-off from which is available for power purposes.

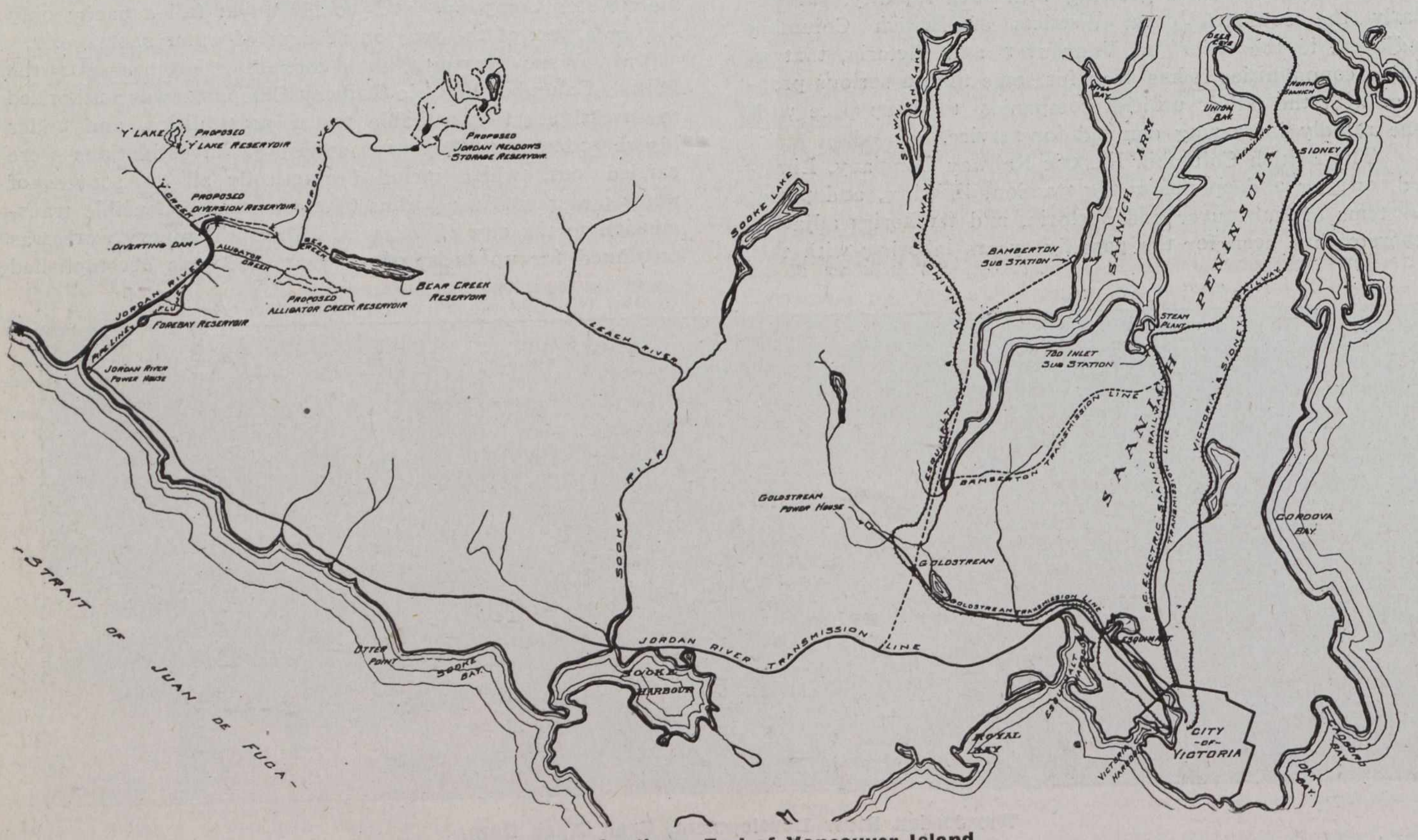
The entire watershed is covered with a very heavy growth of timber, and at the higher levels receives each year a covering of snow from 4 feet to 7 feet in depth, which is gradually melted in the spring, but does not, as a rule, entirely disappear until June or July.

British Columbia is noted for excessive precipitation, and great changes in amount of precipitation in short distances. On the mainland near Vancouver an annual precipitation of 160 inches has been observed, and a variation of 100 per cent. in annual precipitation has been noted in the same season at points only a few miles apart.

The average precipitation over the entire Jordan River watershed, as shown by observations extending over a period of four years, is about 80 inches.

The development has the usual features of storage reservoirs, diverting dams, flumes, forebay reservoir, pressure pipes, power house, transmission lines, and sub-station, but the extraordinary conditions under which the work was accomplished, the development of special methods of meeting the abnormal conditions governing the work, and the details of the execution under these conditions possess more than passing interest.

The Jordan River has a wide variation between summer and winter flow. The highest portion of its watershed is

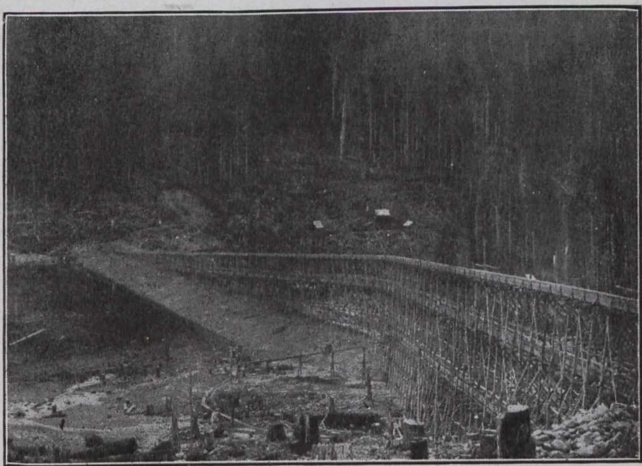


Map of the Southern End of Vancouver Island.

Showing the Jordan River Development in relation to the City of Victoria.

not more than 2,700 feet in elevation. The area possesses features especially calculated to conserve the precipitated waters, more particularly in the dense jungle of forest and underbrush with which it is clothed, the mat of forest floor from 1 foot to 2 feet in depth overlying the soil, the retarded melting of the snow due to the dense shade of the forest, and the moderate transverse slope of the mountain sides. All of these features, however, do not prevent a period of extremely low water, for some 60 to 90 days in the summer and fall of each season.

The stream flow has been systematically observed since 1907, and the results obtained more than sustain the findings of the original report in which the maximum power production of the watershed, based on a 50 per cent. load factor, was placed at 24,000 horse-power, with the commercially feasible storage available.



The Bear Creek Dam Nearly Completed.

It was seen at the beginning of the investigation that a large storage capacity would be required to impound flood waters for use during the dry season. Five favorable reservoir sites were found in the flats and meadows along the upper reaches of the river and its branches. The capacities of these storage basins and the sizes of the impounding dams required have been determined, and the results show that ample storage capacity is available, within reasonable cost, to provide for an ultimate maximum plant output of 24,000 to 36,000 horse-power. These reservoir sites are as follows:

	Height dam.	Capacity, cubic feet.
Bear Creek (initial developent)	55 ft.	320,000,000
Bear Creek (ultimate development) ..	75 ft.	608,000,000
Alligator Creek	35 ft.	95,000,000
"Y" Creek	35 ft.	110,000,000
Jordan Meadows	35 ft.	179,000,000
Diversion Storage	85 ft.	250,000,000

One impounding dam is now completed at Bear Creek reservoir and the other storage sites can be developed as additional generating units are installed to meet the increasing power requirements.

Bear Creek Reservoir.—This reservoir site lies near the head waters of Bear Creek, the dam being about a mile above the junction of that stream with Jordan River, about 4½ miles by wagon road from the diverting dam, and some 13 miles from the power station at the beach.

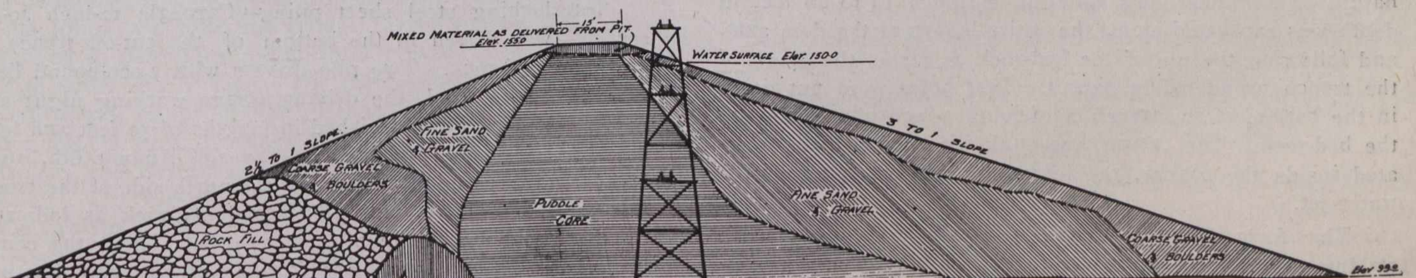
The impounding basin is formed in the long and comparatively narrow valley of Bear Creek, through which the stream winds in a succession of sluggish pools for a distance of some two miles above the site of the dam. The sloping sides of the valley are chiefly of broken and partially metamorphosed slate, covered with soil to a depth of from three to six feet. As the flat bottom of the valley is approached, the bed rock dips gradually from either side toward the centre of the valley, and is topped with a layer of hard-pan—a semi-cemented glacial gravel mixed with clay. This attains a depth of 87 feet in the ancient bed rock channel, which at the dam site is some 300 feet north of the present stream bed. The entire reservoir area supports a heavy growth of fir, spruce, hemlock, red cedar and yellow cedar timber.

The drainage area above the dam is about 8 square miles in extent, gently sloping, and rising to an altitude of about 2,300 feet.

The average precipitation observed at the site during the past two seasons is about 85 inches. In the winter months this precipitation takes the form of snow, which accumulates at times to a depth of 7 feet in the reservoir area.

Until the preliminary construction work began this site was unexplored, except for the rough preliminary survey which had been made in 1908 to determine the general features of the project. In September, 1910, the construction of a wagon road from the diverting point to the dam site was begun, and it was only after its completion late in November of that year that a permanent camp could be installed, and steps taken to determine with certainty the nature of the material underlying the dam site, and the quantity and quality of the material available for the construction of the dam.

The winter and spring of 1911 were spent in investigating the dam site, and the sites for borrow pits. A series of test pits were sunk and borings taken, and in May, 1911, complete data was obtained from which the construction details could be planned.



Section of Earth Dam on Jordan River Development.

The 12", 40 lb. Carnegie steel sheet piling, shown at the bottom of the dam, goes down to bed rock.

The principal dimensions of the dam and reservoir are:

Greatest height above bottom of valley	57 ft.
Greatest height above bottom of sheet piling curtain	127 ft.
Length of crest of dam	1017 ft.
Greatest depth of cut-off trench	31 ft.
Top width of dam	15 ft.
Width of spillway	50 ft.
Depth of spillway below high-water level	10 ft.
Upstream slope of dam	3 to 1

The Intake Tower in Forebay Reservoir.

Downstream slope of dam	2½ to 1
Total volume of dam (embankment measurement)	148,390 cu. yds.
Capacity of reservoir above outlet gates with high-water level 5 ft. below crest of dam	320,000,000 cu. ft.
Area of reservoir at high-water level	284 acres
Drainage area above dam (approximate)	8 sq. miles

In prospecting the site of the dam to determine the nature of the underlying material, a trench 16 to 20 feet in depth was excavated along the entire length of the dam axis, and following the top of the bed-rock as far as the depth of the trench would safely permit. Test holes were put down in the bottom of the trench by driving 3-inch pipe casing to the bed-rock. The casing was sunk with churn drills operated inside the casing, the material being removed with a water jet.

The formation was found generally to consist of a stratum of top soil from two to three feet in thickness, underlying which was a mass of heavy gravel and boulders. At a depth of from 12 to 16 feet the boulders diminished in size, and gave way to coarse, partly cemented gravel, hard enough to offer considerable resistance in removal with picks, below which, and at a depth of about 20 feet, alternating layers of loose sand and gravel carrying water extended to the bed-rock.

With these foundation conditions determined, and in order to provide not only a square foundation for the initial structure 55 feet in height, but for an ultimate structure which would raise the water level 70 feet above the floor of the valley, and double the capacity of the impounding basin, it was decided to install a curtain of steel sheet piling extending to the bed-rock.

After thoroughly prospecting both slopes of the valley, a sufficient amount of suitable material for building the embankment was found on the north side, directly opporite the dam, and distant about 400 feet from the north end of the dam axis. The material consisted of the hard-pan common to the district, gravel and sand mixed with clay, favorably proportioned for sluicing from place into the fill. The borrow pits were 150 to 250 feet in elevation above the valley floor, and afforded a working face or bank 8 to 18 feet high.

Clearing the timber from the dam site and the adjacent areas was begun as soon as men and equipent could be placed on the work. Powder and donkey engines were used extensively in removing stumps and piling the timber and debris for burning. A single acre in the dam site was found to contain 240 stumps of a size to require blasting for removal. The flowage area was not cleared beyond the immediate vicinity of the dam where clearing was required for construction purposes.

After the clearing was finished, and the stumps removed, the forest floor, consisting of partly decomposed vegetation, rotten wood and smaller roots, was removed to a depth of one to two feet from the area to be occupied by the base of the dam. Thirty acres of ground were cleared in all, 10.1 acres of which were stumped, and 4.1 acres stripped.

A cut-off trench, 6 feet wide at the bottom, 10 to 31 feet deep, with side slopes about ¼ to 1, was excavated parallel to the axis of the dam, the centre line of the trench being directly under the downstream edge of the crest of the embankment. The material excavated from the trench consisted of heavy boulders, gravel and sand. Steam and hand-derricks with skips were used in the dryer parts of the trench, while the section under water near the stream bed was removed with an hydraulic elevator. The total volume of material removed was 8,675 cubic yards

Interlocking steel sheet piling—Carnegie 12-inch 40-lb. section—was driven in the bottom of the cut-off trench to the slate bed-rock. Two pile drivers with 2,000-pound drop hammers were used, the driving gangs working night and day. The piles were furnished in lengths of 50 feet and less, the first shipment arriving at the site August 6th, 1911. Hard driving was encountered on the north side of the creek, but no pile was left until it reached bed-rock as indicated by the test holes. The piles were driven along the centre line of the cut-off trench, and from 4 to 6 feet were left projecting above the bottom. The trench was thoroughly cleaned before sluicing was started.

Total number of steel sheet piles driven	616
Total length of steel cut-off	580.5 feet
Net length cut-off per pile	about 11½ in.
Maximum penetration of pile below bottom of cut-off trench	68.5 feet
Average penetration of pile below bottom of cut-off trench	about 46.3 feet
Maximum penetration of pile below original ground surface	87.0 feet
Total piling driven	28,509.0 feet
Total weight of piling	570 tons

A permanent flood water spillway having a net opening 50 feet wide by 10 feet deep below the high-water level of the reservoir, was excavated in solid slate bed-rock around the north end of the dam. The spillway cut was about 350 feet in length by 35 feet maximum depth, with side slopes ¼ to 1. The larger part of the work was done under contract before sluicing was started, the rock being placed in the downstream toe of the dam.

Six concrete piers were erected in the throat of the spillway, against which timber stop-logs can be set horizontally to hold the pond at any desired level. A platform or runway extends from pier to pier, and an overhead cable with traveling tackle is provided for handling the stop-logs. The floor of the spillway is paved between piers and downstream for a distance of 10 feet. A concrete cut-off wall extending into impervious solid rock, is provided at the upstream end of the spillway piers. A second concrete cut-off wall, founded on bed-rock, extends from the south abutment to the puddle core of the dam.

The total quantity of material removed from the spillway was 11,267 cubic yards, of which 10,431 cubic yards was rock, and 836 cubic yards earth.

The masonry used in the piers, cut-off walls, paving, etc., amounts to 110 yards.

The material was placed in the dam by sluicing, except the rock from the spillway cut, and the material excavated from the cut-off trench, the material not sluiced amounting to 13,985 cubic yards in all.

A gravity supply of water for sluicing was obtained from a small creek on the north slope of the valley near the dam site. A storage reservoir was built on the ridge near the headwaters of the stream in which about 1,500,000 cubic feet of water were stored, sufficient to operate the sluices for a period of 5 to 7 days, depending upon weather condition. The water was taken from the creek at a point about two miles below the storage reservoir in a 10-inch spiral wound woodstave pipe, 1,300 feet in length, discharged into a head box from which a rivetted steel slip joint hydraulic pipe No. 12 gauge, 8-inch diameter, was laid to the borrow pits, the water being delivered at the nozzles with a static head of from 150 to 200 feet.

Owing to the necessity of completing the dam in time to store water for use at the power station during the summer of 1912, and in order to preclude, as far as possible, interruptions in sluicing from failure of the gravity supply, a pumping plant was installed below the dam near the creek, and pipes laid from the pumps to the borrow pits, all arranged to permit changing from gravity to pumped supply with small loss of time. The plant consisted of two 3-stage centrifugal pumps, 6-inch discharge, capacity 1,000 gallons per minute each, driven with steam engines. Four 50-h.p. boilers were installed, and wood from the site was used for fuel. The pumping plant was put into service whenever the gravity supply ran low.

Sluicing flumes for carrying the material were erected from the borrow pits, and extended the full length of the dam. The grade of slope of the boxes was 6 per cent. on the main flumes, the size of box being 16 inches wide by 18 inches deep, built of 2-inch plank, and lined in the bottom with wood paving blocks 4 inches deep. The lateral or distributing flumes were given a grade of from 7 per cent. to 9 per cent., were not lined, and were built with lap or telescopic joints to facilitate moving.

Three decks or levels of flume were used as the work progressed, the maximum height of supporting trestle being 70 feet. The trestle posts were round poles, cut on the site. The total length of flume erected for the work was:

First of lowest deck	1,050 feet
Second deck	1,150 "
Third deck	1,400 "
Lateral or distributing flumes..	3,000 "
Total	6,600 feet

About 360,000 board feet of lumber were used in the course of the entire work, the larger portion of which was in the sluicing flumes.

Sluicing was started September 1st, 1911, and carried forward night and day during the winter and spring until April 15th, 1912, when the fill was completed. More or less serious delays, due to freezing weather, snow-fall, maintaining temporary spillway through the dam for discharging flood water, and minor interruptions, were experienced; but in spite of these the average progress was better than anticipated, the estimated date of completion being May 15th.

The water in the reservoir was raised gradually as work of building the dam proceeded, no run-off being wasted after March 1st, 1912. At the date of completion the water level in the pond stood at the elevation of the spillway floor. Extremely dry weather conditions prevailed during the spring, and the basin failed to fill, the highest level reached being about 7 feet below the high-water level. The storage obtained, however—250,000,000 cubic feet—is sufficient for normal plant operation with one machine during the summer. The second unit which is being installed by the company will not be ready for service before the coming of the wet season.

Diversion Dam on the Jordan River Development.

The quantities and classification of material in the dam are:—

Excavation measurement:

Rock from spillway and gravel cut-off trench..	13,985 cu. yds.
Material sluiced from borrow pits	129,364 cu. yds.
Total	143,349 cu. yds.

Embankment measurement, completed structure	148,390 cu. yds.
Excess of embankment over excavation measurement	5,041 cu. yds.
Excess of embankment over excavation measurement	36 per cent.

No attempt was made to break the hard-pan formation in the pits with the water from the monitors. Powder was used throughout the work for breaking down, holes being gophered in the base of the bank to a depth of 10 to 16 feet. A gang of men was kept constantly at work with picks, breaking up the larger masses to assist the action of the monitor stream. In fact, it was endeavored at all times to keep the solid material coming at a rate to utilize the full carrying power of the water flowing to the sluices. The quantity of water used in sluicing varied from 3 to 6 cubic feet per second, which was discharged through 3-inch and 4-inch nozzles in the pit. The following table gives a summary of the sluicing records:

Sluicing Record, Bear Creek Dam.

DATE	% time sluicing	Hours sluicing	Water used avge. in second feet	Cubic yards Placed	Propor-tion solids to water	Cubic yds. per 24 hrs. sluicing time
1911.						
Sept., 30 days	70 %	504	3.53	17,085	7.2%	813
Oct., 31 days	43.5%	322.8	3.2	10,300	7.3%	765
Nov., 30 days	51.9%	373	6.25	14,950	4.8%	964
Dec., 31 days	66.4%	493.5	6.25	18,150	4.4%	888
Jan., 31 days	85.6%	637	4.7	19,600	4.9%	740
Feb., 29 days	99.9%	694.5	4.3	29,650	7.5%	1110
Mar., 30 days	69.2%	518.8	3.4	17,300	4.4%	802
Apr., 15 days	48.5%	174.4	4.3	7,370	7.3%	1060
	66.9%			134,405	6.3%	893

Remarks:
October—Delay, waiting for free or gravity water.
November—Delay, waiting for free or gravity water.
Delay due to freezing weather.
December—Delay due to flood through temporary spillway.
January—Delay removing temporary spillway.
Delay due to freezing weather.
March—Delay draining fill.
April—Delay, slow work finishing crest.

A temporary spillway was maintained through the dam during the winter season, the maximum observed flood discharge through which amounted to 1,300 second feet. The structure was removed about January 1st, 1912, after which, and until the elevation of the permanent spillway was reached, an emergency overflow spillway was maintained over the dam, with plank apron attached to timbers embedded in the fill extending down the slope. The necessity of using this emergency overflow never arose. By manipulating the permanent outlet gates, the water was varied to provide storage in the main pond for floods in the stream, and the peaks were all safely passed without the water level reaching the top of the dam.

Outlet Structure.—Two 30-inch riveted steel pipes, ¼ inch thick, each 300 ft. long, are installed in the base of the dam, immediately south of the original stream bed. The trench in which the pipes are laid is excavated in the bed-rock, and backfilled with concrete which forms a casing around the pipes one foot thick on all sides. At the upper end of the pipes a reinforced concrete intake structure with screens is provided. This contains two 24-inch hydraulic gate valves with stems extended to a platform at the top of a structural steel tower 50 feet in height, from which the valves are operated. Venturi tapers were inserted in the pipes on both sides of the valves to minimize flowage losses through the 24-inch valves, made smaller than the pipe merely for sake of economy.

The excavation for the outlet works amounted to 3,730 cubic yards and 343 cubic yards of concrete was used in pipe casing and head works.

The behavior of the dam since completion has been most satisfactory. Measuring weirs set at points below the dam to intercept the water flowing by the dam, show that the aggregate discernable loss on April 4th, 1912, was .191 second feet, which was decreased on April 27th to .100 second feet. Subsequent reports indicate that the loss is steadily diminishing as the body of the fill gradually drains out.

The desirability of raising the height of this dam to obtain additional storage will no doubt appear shortly. The undertaking will be comparatively simple with the apparatus now on the site, a safe foundation installed, and all the perplexing and expensive features of design, methods, and transportation solved. By raising the embankment 20 feet the capacity of the storage basin may be increased to 608,000,000 cubic feet.

Diversion.—Two diverting dams, one in the main Jordan River, and one in "Y" Creek, a tributary stream, were installed.

Immediately below the junction of "Y" Creek with Jordan River the canyon narrows, and a ridge of outcropping bed-rock crosses the stream and extends well up the steep slopes on both sides of the canyon, forming a site well adapted for the placing of a concrete or masonry dam. It was originally planned to place the diverting dam at this point, but owing to limited time, the lack of a supply of concrete material nearer than the beach, and further, in view of the possibility of utilizing the site for the construction of a high masonry dam, which would, in addition to diverting the stream into the flume, form a large impounding reservoir in the valleys above, this site was reserved for the erection of the more permanent and higher structure at some later time, and a site for the main initial diversion was selected some 2,000 feet further up the stream.

The diverting dam on "Y" Creek was built a short distance above its junction with Jordan River, and a branch flume installed, which carries the water down the west side of the stream, crosses the main river on a timber truss 60 feet long, and discharges directly into the main flume.

The main Jordan River diverting dam is a log crib filled with rock resting throughout on solid rock. Rock from the excavation for the intake basin was used to fill the cribs. Timber cut adjacent to the site was used in the construction, the logs being notched and drift-bolted together, and thoroughly pinned to the underlying bed-rock. The top, upstream and downstream faces of the dam are sheathed with a double thickness of 2-inch plank laid with broken joints. The general dimensions of the dam are:

Length of crest	127 feet
Top width	8 feet
Upstream slope	1 to 1
Downstream slope	1 to 1
Maximum height	18 feet

Three timber head gates, with rack and pinion operating gear, are provided to regulate flow of water into the intake basin, which is also formed of log cribs, backfilled with rock, and lined with plank for water-tightness. At the lower end, and immediately above the flume entrance, sand gates are provided, depressed two feet below the flume floor, through which silt and sand collecting in the bottom of the intake basin may be discharged.

The dam has withstood the floods of two seasons, nearly 8 feet depth of water having passed over the crest at the highest stage, and at low-water the observed leakage is practically nothing. The "Y" Creek diverting dam is similar in type to the main dam already described, the crest, however, being only 90 feet in length.

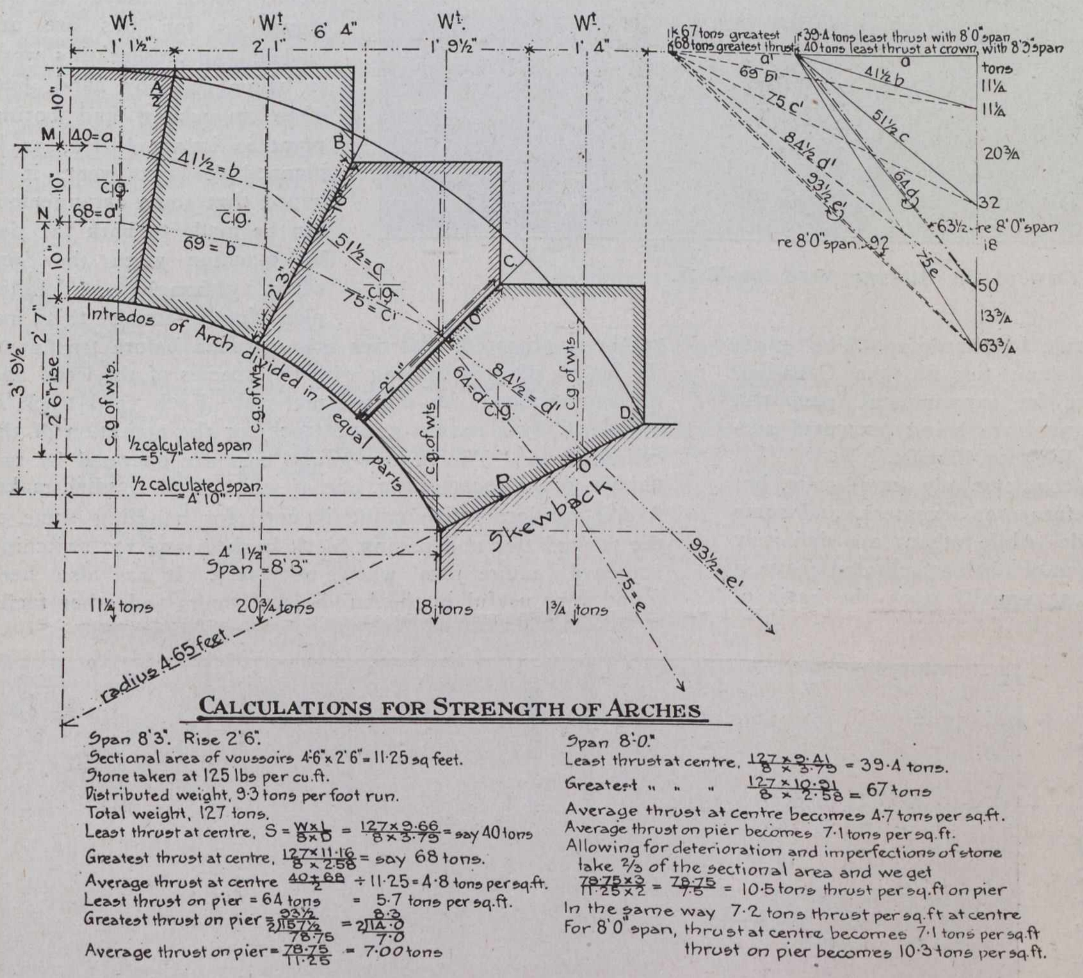
Main Flume.—The main flume follows the south side of the Jordan River canyon for a distance of about 5½ miles. The side of the canyon is precipitous at points, the slope being frequently broken with deep indentations. The formation, as a rule, is stable, and favorable for the flume foundation, consisting generally of hardpan or solid rock, topped with a comparatively thin layer of soil.

(To be continued next week).

CALCULATIONS FOR THE STRENGTH OF ARCHES.

By Leonard Goodday, C.E and M.E., late of the British Admiralty.

This paper is written with the intention of putting forward clearly a simple and practical method of obtaining the thrust on each voussoir, and finally on the skewback, with accurate results. In most cases it is taken for granted that the reader will understand the reason of each step, and, consequently, no explanation is given. The result is that too often a formula is used without the true principle or knowledge of its construction being known. The example given below was calculated for an engine-house which was built some years ago in the East.



Calculations and Stress Diagram for Design of Arch.

The method given for finding the least line of resistance and thrusts on the skewback is by graphic strains, which, when drawn carefully to a large scale, is very quick and accurate, and can, of course, be checked mathematically if required. The arch had a clear span of 8′ 3″ with a rise of 2′ 6″ and 4.65′ radius, and was made up of seven voussoirs of equal section for calculation, viz., 4′ 6″ x 2′ 6″. As it is necessary to have the least line of resistance within the middle third M.N.O.P. on the section, divide the arch at its centre and at the skewback into three equal parts, and obtain the spans and vertical distances as on the diagram for the calculation of the least and greatest thrusts at the centre preparatory to constructing the stress diagram. The vertical dotted lines indicate the centres of the distributed weights on each voussoir, and the centre of gravity of each stone is indicated by c. g., whilst the vertical full lines represent the centre of gravity of the total weights, including voussoirs. To obtain the least thrust at centre, the shortest span and greatest depth of the middle third should be taken, and for the greatest thrust the longest span and least depth should be taken.

It will be noticed that each thrust is lettered the same as the voussoir upon which it acts, the only difference being for the greatest thrusts which have a dash over them.

The construction of the stress diagram is as follows:—

Draw to scale the horizontal thrust a, equal to 40 tons as calculated.

From the right-hand end draw the vertical line, composed of the weights in rotation, commencing from the centre of arch.

From the left-hand end draw the lines b, c, d, e to the ends of each line representing the weights. Next, draw to scale the greatest horizontal thrust a′, equal to 68 tons as calculated, and proceed as before and as shown. This completes the resolution of forces, which are built up step by step.

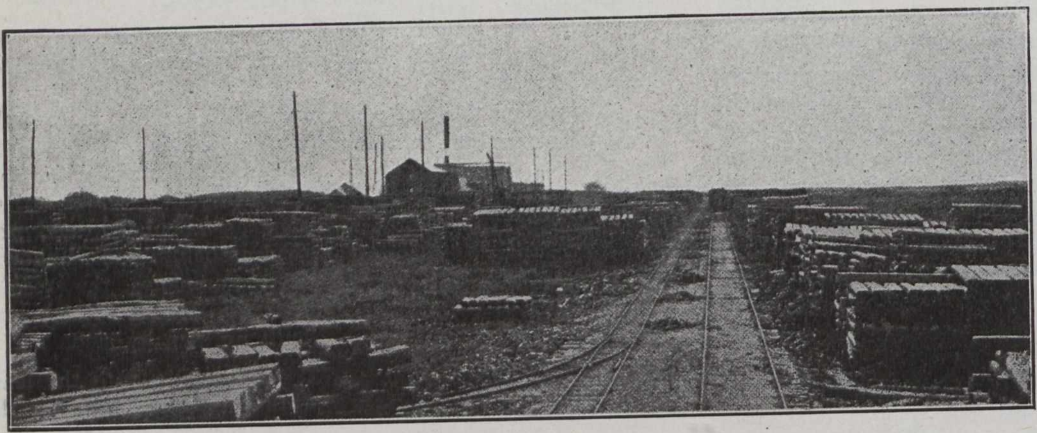
Beginning with the least thrust at the crown on the half section of arch, draw the horizontal thrust a from the point M until it intersects the centre line of weight through voussoir a, and from this point draw the line b parallel to the line b on the stress diagram until it intersects the centre line of weight through voussoir B, and so on to thrust d on skewback, viz., 64 tons, which equals the least thrust. For the greatest thrust at centre, viz., 68 tons, draw the horizontal thrust a′ from the point N until it intersects the centre of weight through voussoir a, and continue as before to thrust e′ on skewback, viz., 93½ tons, which equals the greatest thrust. From these thrusts the average thrust per square foot is obtained on the skewback and centre of arch, as shown in the calculations given below the sketch and stress diagram; and lastly, the thrust per square foot for a sectional area of two-thirds the sectional area of the voussoir, for reasons already explained.

The final results and the course of the line of resistance now obtained show that the stability of the arch is certain, and the profile of the voussoirs may be drawn out.

To do this mark off from the least line of resistance one-third of the depth, viz., 10 inches at the first and second points from the skewbacks, and construct the voussoirs, which, as will be seen, are in proper and uniform proportion to one another. The stability of an arch of this type is easier to obtain than a semi-circular one, as it is most difficult to keep the line of resistance within the middle third, an arch of this form cannot be crippled if properly constructed.

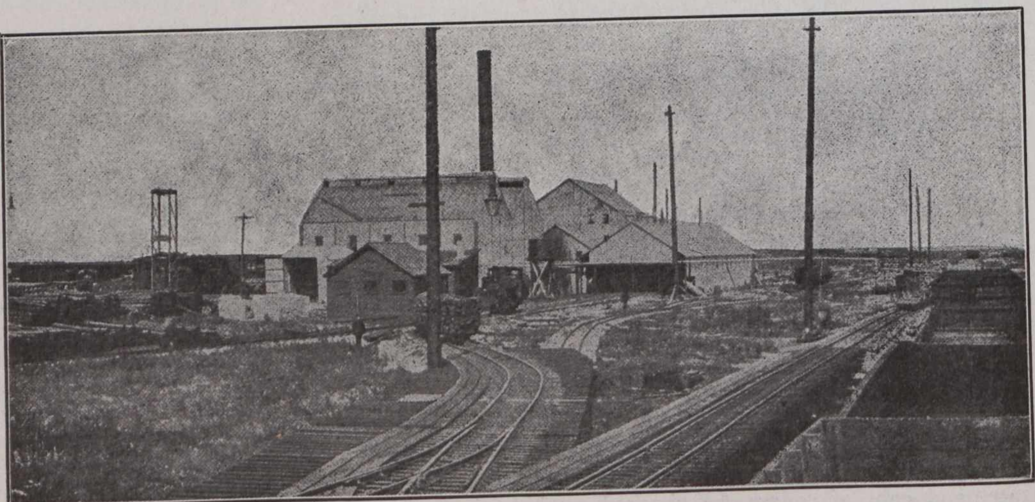
THE NEW PLANT OF THE DOMINION TAR AND CHEMICAL COMPANY, LIMITED.

The Dominion Tar and Chemical Company, Limited, has just erected a creosoting plant for the treatment of railway ties. The plant is located about six miles east of Winnipeg and is now operating. The plant has a contract to treat from 500,000 to 1,000,000 ties for the Canadian Pacific annually for ten years, which marks the first use of treated timber for ties on a large scale by that road. The plant also has a contract to treat some ties for the Canadian Northern, which will be used for experimental purposes, and large paving block contracts are being executed successfully for various cities in Western Canada.



A View of the Storage Yard for Ties.

The plant was built on a comparatively small scale, but was designed with a view to future enlargement, and some additions are now being made, while others are definitely planned. The two cylinders now being operated have a capacity of over a million ties annually upon the basis of present operations. The ties treated are principally jack pine, Norway pine, tamarack and white spruce, while some experiments are being made with British Columbia spruce and fir, and black spruce and poplar from Ontario. Although some of these species are not as well adapted to treatment as some other woods, they are used because they are easily obtainable along the company's lines. The climatic conditions in Canada are such that decay in ties is not so rapid as on roads located further south, the period of the year in which the frost is out of the ground, which is the only time that decay can seriously affect the wood being much shorter. The plant is equipped to treat timber by any method. The C.P.R. and C.N.R. contracts specify the Bethell process, injecting a minimum of two United States gallons per tie. The ties are receiving from 2 to 3½ gallons, depending upon the size of the ties. The process consists of preliminary steaming, when the timber is not air-seasoned, followed by a vacuum, after which the cylinder is filled with creosote and the desired amount of oil injected into the timber. After the oil is ejected from the cylinder, the timber is allowed to stand a short time to recover the drippings. Most of the oil used is secured from the distilling plants which the Dominion Tar and Chemical Company operates at Sault Ste. Marie, Ont., and Sydney, N.S.



General View, Showing Treating Plant.

The treating plant occupies a tract of 40 acres, with the buildings located near one end of the yard. It is planned to add 30 acres to this next year, which can readily be done, as the company owns 110 acres. There are four long yard tracks serving the storage piles, which are designed to accommodate 700,000 ties, and the additional yard space planned for next year will provide for the stacking of over a million ties.

Practically all of the ties that reach the plant are shipped with the bark on the sides, which must be removed as the ties are unloaded. At present this work is being done by hand, but, when an adzing and boring plant is installed, as is planned for next year, it is hoped that some arrangement can be made to bark the ties by machine when they are adzed, although no detailed plan for effecting this has yet been prepared. All ties are seasoned before treatment, the length of time varying with the species of the wood and the requirements for treated material. Each yard track is paralleled by a narrow-gauge track for the operation of the cylinder cars. The narrow-gauge cars are operated by two narrow-gauge locomotives, one of which is of English make. A five-ton locomotive crane is used for handling some of the treated ties and paving block baskets and for switching standard gauge cars when necessary. It has also been found very useful in the building of tanks and other facilities about the plant. The yard is connected at one end with the main line of the Canadian Pacific and at the other with a branch line of the Canadian Northern. An elevated loading platform of frame trestle construction is provided for loading treated ties in standard gauge cars for shipment. This platform is served by two narrow-gauge tracks.

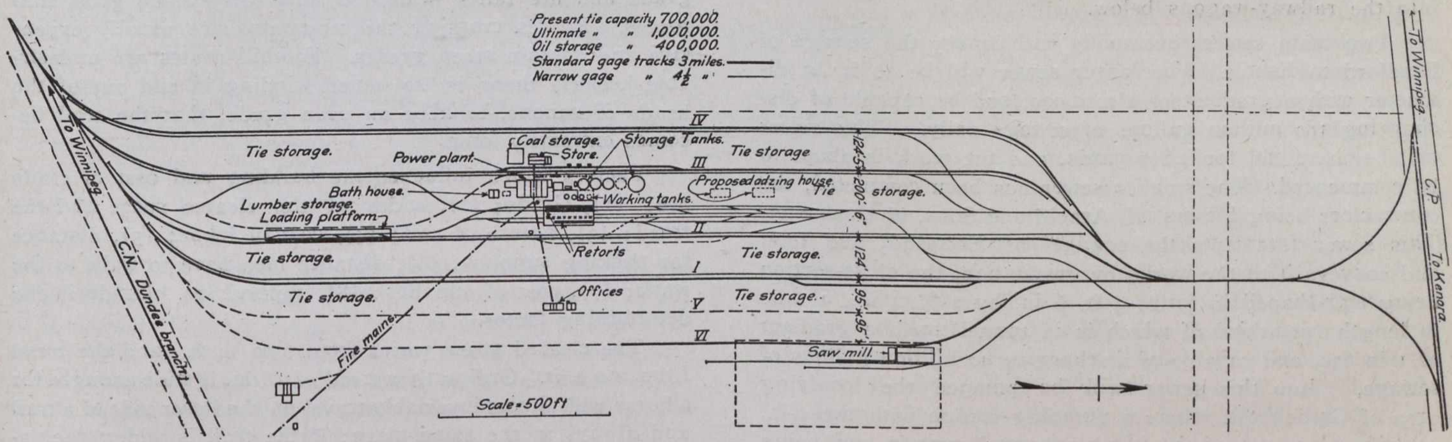
The treating plant is housed in steel frame buildings covered with corrugated iron. There are two treating cylinders 6 ft. 6 in. in diameter and 135 ft. long now in use, a third one 6 ft. 6 in. in diameter and 84 ft. long is practically completed, and a fourth one 6 ft. 6 in. in diameter and 135 ft. long has been ordered. The present cylinders have a capacity of 16 trains to a charge. The cylinder doors are swung from a crane attached to the cylinder, and when closed are secured by 24 clamps. These clamps are of heavier construction than that commonly used in creosoting plants in the United States. The cylinders are supported on I-beams carried on concrete foundations, with a special channel and I-beam construction at the expansion joints.

Two working tanks, 20 ft. in diameter and 14 ft. high, with a capacity of 34,500 gallons, supply oil to the cylinders through 8-in. pipes. A third working tank of the same size is practically completed and ready to operate. Compressed air is used to force the oil back when the pressure is removed. Recording thermometers and gauges are provided in the engine-room, which make a permanent record of the temperature and pressure in each cylinder during treatment, and a similar gauge registers the vacuum. Indicator gauges are also provided to show the amount of oil in the working tanks. The engine-room is equipped with three oil-pressure pumps, two vacuum pumps and two air compressors. The piping from the oil pumps is so arranged that either pump can force oil into either cylinder, thus eliminating the necessity for delay when either pump is out of order. Steam for the plant is supplied by two 450 horse-power Babcock and Wilcox boilers. Boiler water is secured from wells, and is treated by a soda and lime softening process. The boiler feed water is heated by a Cochrane heater. A 350-amp. 100-volt generator direct connected to a 50 horse-power engine furnishes electricity for 16 arc lamps and 350 incandescent lamps throughout the yard and the buildings.

A machine shop alongside the boiler plant is able to take care of minor repairs, and the locomotive house adjacent to the machine shop is used to store the yard locomotives. A bath-house is provided in the yard for the use of the 135 or more workmen which the plant employs. This house is equipped with two showers and four tubs. A boarding-house is furnished by the company near the yard for the accommodation of the workmen. The supply of creosote for the plant is kept in three storage tanks at present, one 40 ft. in diameter and 25 ft. high, and two 30 ft. in diameter and 15 ft. high. Two additional 30-ft. tanks 15 ft. high have been ordered and will be erected this year.

Mr. E. Bernard Smith, the general manager of the Dominion Tar and Chemical Company has recently removed his office, which is the head office of the company, from Sault St. Marie to the new Birks Building, Montreal.

The plant is operated under the direction of F. W. Zoates, manager for the Dominion Tar and Chemical Company, and G. G. Roberts, assistant manager. J. H. Dixon is the representative of the Canadian Pacific at the plant.



Plan of Layout of Creosoting Plant.

THE TREATMENT OF SEWAGE SLUDGE.

One of the largest schemes for the treatment of sewage, entailing an expenditure of $6,000,000, is now being carried out by the corporation of Bradford, England. The original works at Frizinghall having proved to be inadequate, an estate at Esholt, covering an area of 1,856 acres, was purchased in 1906, situated to the northeast of the city, and about six miles distant from the centre of the town.

The plant for dealing with the sludge has been removed from the old works at Frizinghall and housed in new and commodious buildings at Esholt; and since it has been found necessary to retain for the time being the old precipitation tanks at Frizinghall for the collection of the sludge, a temporary 8-in. steel pipe-line has been laid down, some five miles long, to deliver sludge to the new works. The main which follows the towpath of the Bradford and Leeds and Liverpool Canals has been laid in such a manner that it has sometimes a falling gradient and sometimes a rising gradient, whilst a great length of it is level. The total fall from the inlet to the outlet end is 70 ft. In order to get sufficient velocity to discharge 500 tons of thick sludge, containing only 80 per cent. of water, compressed air is fed into the main with the sludge, and this is the Pohle air lift worked upside down. It is found that the pressure on the inlet end varies from 30 lb. to 40 lb. per sq. in. The sludge is fed into the main by compressed-air-operated sludge-rams.

The new buildings, which cover 1¼ acres, are faced with a coarse sandstone. The design is in keeping with the nature of the stone, being massive and rugged in appearance, and the moulds simple, but bold.

In addition to the boiler-house, engine-house, and water-tower there is a press-house measuring 237 ft. by 92 ft., which contains 128 sludge-presses—64 of which have been made by Messrs. Manlove, Alliott and Co., Limited, of Nottingham; 36 by Messrs. John Wilson and Sons (Johnstone), Limited, of Johnstone; and 28 are now being made by Messrs. Knowles and Co., of Bradford, to complete the installation of 128. The grease-house, measuring 237 ft. by 50 ft., contains 16 grease-vats, each capable of purifying 6 tons of grease, with a grease storage tank under, capable of holding 1,000 tons; also grease separators, sludge-boiling vats, and rams.

The sewage of Bradford presents unique features on account of its strength, character, and concentrated condition, for which the trade refuse discharged into the sewers is responsible, and on account of this peculiar character the sludge-disposal works present novel features, being designed for the recovery of grease from the sludge. The method adopted by Mr. Garfield, the engineer of the scheme, is as follows: The sludge, on its arrival at the receiving-tanks, is lifted to the boiling-up vats by means of compressed air. here it is heated by live steam, and passed into three steel vessels placed underneath, and from which it is forced by compressed air to the sludge-filter presses. Each press contains forty-seven chambers, 3 ft. square. The object of heating the sludge is to facilitate the filter pressing, and to render liquid the grease contained in the sludge. The grease and water coming away from the filter-presses are separated in tanks, from which the water is pumped back again into the sewage, and the grease into the purification-vats.

From these vats the grease is run into barrels, pumped into tank-wagons on the adjoining railroad, or discharged into the storage-vats, whichever may be necessary. It has been found that the 100 filter presses now in operation produce from 12 to 15 tons of grease per twenty-four hours, which is valued at from 8l. to 10l. per ton, and the resulting cake is more valuable than that usually produced, consequent upon the fact that it contains no lime and only 28 to 30 per cent. of moisture. It is sold at the price of 3s. per ton at the works, where it is loaded direct from the filter-presses into the railway-wagons below.

Two main sewers eventually will convey the sewage of Bradford to Esholt. The larger sewer will be 10 ft. in diameter with a gradient of 1 in 2,000, and be capable of discharging 180 million gallons of sewage daily. This sewer will be in tunnel for 4,807 yards, and the work is about to be commenced. The smaller sewer has been completed, the contractors being Messrs. H. Arnold and Sons, of Doncaster. This sewer intercepts the sewage of Eccleshill and Idle, and conveys it to the works by gravitation, the cross-section being egg-shaped in form, 3 ft. 6 in. by 2 ft. 4 in., 1 mile in length (one-third of which is in tunnel) with a gradient of 1 in 630, and capable of discharging 12 million gallons of sewage. Into this sewer will be pumped the low-lying area of Greengates, where a pumping station with two 6-in. centrifugal pumps of the "Stereophagus" type is now being erected. These pumps will be electrically driven and automatically controlled, and have been designed to pass unscreened sewage. They are capable of raising 2,000,000 gallons of sewage and trade effluent through a 12-in. rising main to a height of 100 ft. daily. Tanks have been provided at the works to treat temporarily the sewage of these districts and of the district of Yeadon by chemical precipitation, the effluent being finally purified by land filtration.

The engineer of the scheme is Mr. Joseph Garfield, Assoc.M.Inst.C.E. For the 10-ft. diameter sewer and Aire Valley Crossing the engineers are Messrs. James Watson, M.Inst.C.E., and Joseph Garfield, Assoc.M.Inst.C.E., acting jointly; whilst the resident engineer is Mr. Howard Wontner-Smith, Assoc.M.Inst.C.E.

TRAIL LOCATION AND CONSTRUCTION.

In a paper published in the Forest Club Annual of the University of Nebraska, Mr. Ernest Wohlenberg gives an interesting discussion on trail location and construction. He states that the first and most important consideration in trail construction is always the location, and grade is the determining factor in location. Where it is steep, switchbacks should be resorted to. The methods used in location are: (1) Compass and Abney hand level (accurate); (2) hand level only (fairly accurate), and (3) ocular levelling (inaccurate).

A route should first be reconnoitered and definitely decided upon before it is staked out. The main points can be sketched in on a map by means of a compass and hand level. On short distances the hand level will be sufficient. Laying out by eye is a poor method and inaccurate at its best. The route should be staked every 50 to 100 ft. and blazed, but as a usual thing routes are laid out by blazing only. The blazes should be made close together along the trail so that there will never be any trouble in following them. Location should always be from the top of a hill to the bottom, otherwise the maximum grade is apt to be exceeded, because in locating from the bottom there is danger of making the grade steeper than necessary. Location work can be done with a crew of three men and costs from $2 to $10 per mile.

There are several choices for trail routes: (1), Valley or canon; (2), ridge route; (3), trails crossing mountains, and (4), foothill. The use of one of the first two routes depends somewhat on the nature of the country. Where the canons are extremely steep, narrow, and full of boxes or interrupted by cliffs, the ridges and sidehills can be followed without much trouble. For the latter, the south sidehills should be used, because they are passable three weeks earlier in spring and later in autumn than north hillsides. Where the country has been worn down the valleys have a gentle grade and are fairly wide, so that they make good trail routes. Routes crossing the mountains are usually expensive and contain steep grades. Foothill routes are undesirable because there is so much winding in and out of the heads of canons, to keep an even grade, that the trail becomes extremely long.

Factors which influence the building and cost of trails are: (1), Grade; (2), width of the cleared space and the tread; (3), nature of soil; (4), cost of labor; (5), distance for packing supplies; (6), distance men have to walk to the work; (7), cost of supplies; (8), supervision. Grade is the determining factor.

The cleared space varies from 6 to 14 ft., and the tread from 1 to 4 ft. Ordinarily a tread of 18 in. is wide enough, for a horse will almost invariably travel on the lower side of a trail and always in the same place; if the trail is wider, the inside will fill up with sliding material and the extra cost in excavation will be thrown away. On turns, trails are widened and on switchbacks the width is doubled. The trail bed should be flat. Excavation should be made into the bank instead of building up the outer side of the trail, because on steep slopes earth thrown out of the trail makes a poor footing. The supervision of the crew is a most important factor, for if the work is not arranged as it should be, the trail will be expensive under the most favorable conditions.

The size of the crews varies from 2 to 15 men. In crews of 8 to 15 men it is necessary to have a cook, a packer, and a foreman. The brushing out can be done by 2 to 4 men, while 5 to 8 can do the grading. Small crews vary from 2 to 5 men.

On side-hill locations where water will run down a trail, it is always best to put in water bars; that is, small ditches 2 to 4 in. deep, running diagonally across the trail and banked on the lower side with earth or a small log sunk a few inches in the ground. These will turn the water and prevent any great amount of washing, which might ruin a trail. The number of water bars will vary with the grade of the trail and the degree of slope of the side hill. It is much cheaper to put them in when building the trail than afterward. Under ordinary conditions they can be located from 150 to 225 ft. apart. In building a trail, the country should first be reconnoitered and the route fully decided upon. It should then be located by stakes or blazes, and cleared and brushed, after which it will be graded and the tread formed to the specified width.

A NEW TYPE OF WATER TURBINE CHAMBER.

At low-head developments it is a common occurrence that during periods of floods the tail race water level raises to a considerable height and the endeavor of the designers of water turbine plants has been to place the electrical machinery and the power house floor above the highest tail water level experienced. In order to accomplish this use has been made of the arrangement with vertical shaft, whereby it is possible to place the generator at any height above the water level by only lengthening the shaft. However, this arrangement with vertical shaft has various well-known drawbacks as the accessibility of the turbine suffers greatly, and the dismantling of same is very complicated and requires a long time. The desirability of being able to install at low heads, as above described, horizontally arranged water turbines led the firm of Escher Wyss & Company to the design of a turbine chamber with artificially raised head water level.

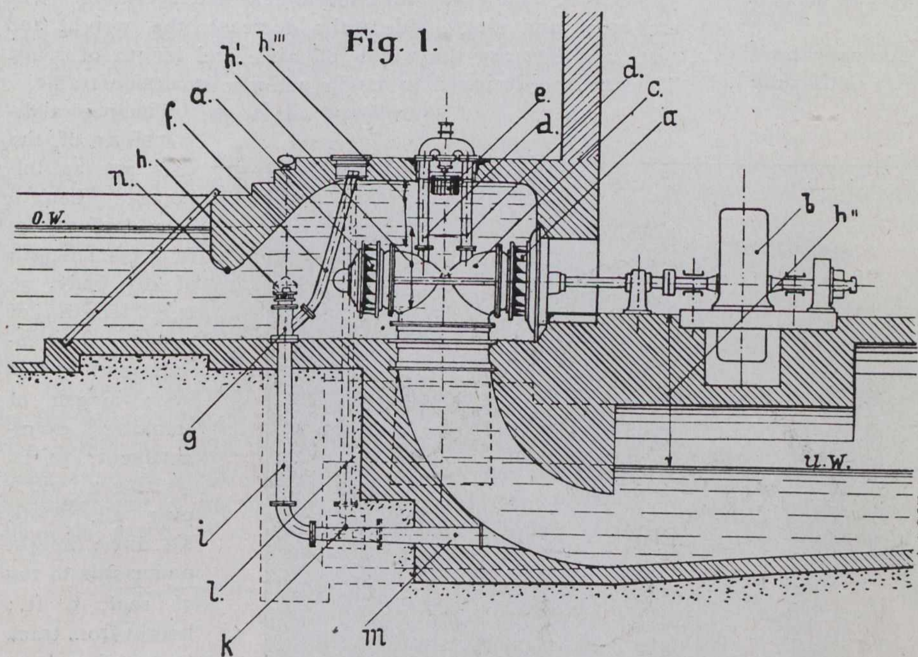


Fig. 1.

In order to ensure proper working of water turbines installed in open water chamber, it is necessary that the turbine be submerged to a certain extent so as to prevent any air from entering the machine, whereby the efficiency and the power would be decreased considerably.

The above mentioned arrangement, with artificially raised water level enables the designer to place the upper edge of the turbine (no matter if the shaft is arranged horizontally or vertically) slightly below the head water level. The advantages of thus placing the machine as much elevated above the tail water (of course within the possibility of proper suction) is: Firstly, that the direct coupled generator may be located considerably higher above tail water level than previously was possible, and secondly, that the excavation required for the tail race canal, and consequently the expense is reduced to a great extent. It goes without saying that the same advantage is gained if the turbine is of the vertical or horizontal type.

This method of artificially raising the head water level is of late very often adopted, and in special cases with the greatest advantage. The patent for this arrangement has been taken out by Escher Wyss & Company in most countries, and the demand for this kind of installations has increased very rapidly, so that quite a number of plants of this type are in operation at the present time. The raising of the head water level may be effected in different ways. Reference is directed to the illustrations, Figs. 1 and 2. There will be observed that the wheel pit is covered by a concrete roof, which is made air-tight. By sucking the air which remains between the head water level and the concrete roof the water level is raised gradually until the whole wheel pit is completely filled with water.

There are two different methods of obtaining this. The first method works automatically in the following way: As soon as the turbines open the water discharges through same and sucks through the pipes "D" attached to the draft chest, the air, thereby gradually the water (of course within the possibility of whole chamber is filled. As soon as the chamber is full an automatic float valve closes the pipes "D" so that no more water is discharged through the draft chest and consequently very little water is actually wasted. The other method consists of a separate connection between the water chamber and the draft tube, which is opened by hand, and discharges the water through same continuously during the operation of the turbine. In consequence, this quantity of water is wasted.

With the first method the turbine has to be put in operation before the wheel chamber is being filled and the level raised. With the second method the wheel chamber might be filled and the head water level raised before the turbines are opened and put in operation. Fig. 2 depicts a similar arrangement adapted to a vertical turbine installation.

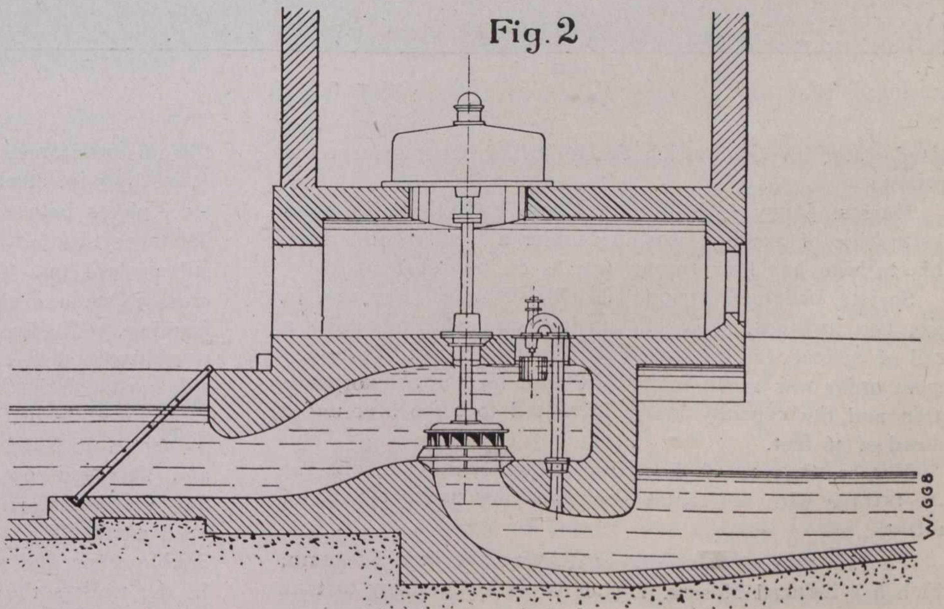


Fig. 2

Fig. 3 shows a cross section of such a water chamber with the turbine units erected. The automatic air sucking off devices with float valves are shown in the upper vaults on each side of the inspection shaft, in the centre of the chamber. The three first turbines working with this patent are in operation in Unterbruck, Bavaria, for the Amperwerke Electric Works, Munich, and were started up in 1908 and have been working with entire satisfaction since. The Unterbruck installation contains three turbines each with four runners having an output of 650 h.p. at a head of 15½ feet.

Since that time Messrs. Escher Wyss & Company have constructed a great many turbines working with artificially

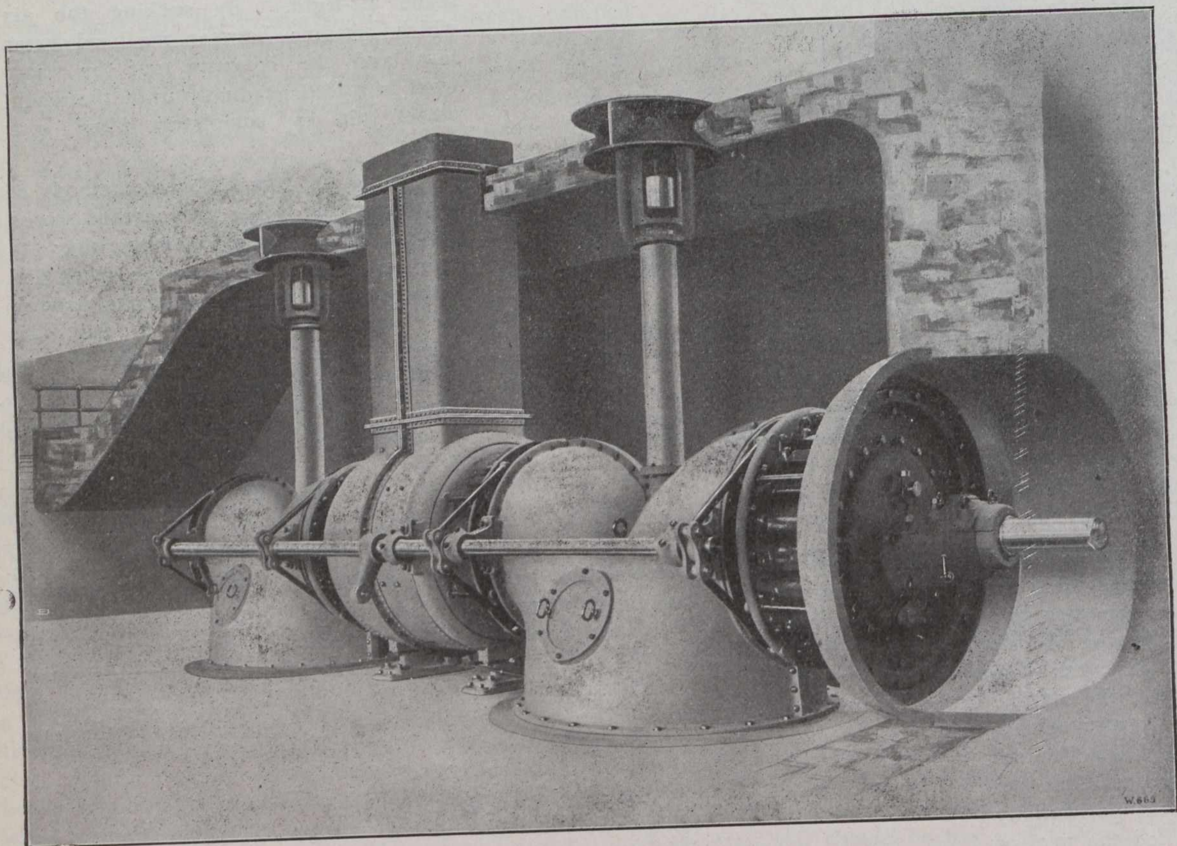


Fig. 3.

raised water level, of which the following are the most important:

Messrs. Jenny & Schindler, Kennelbach-Tirol, in 1910, one turbine of 250 h.p. working under a head of 10½ feet. This turbine has four runner wheels on one shaft.

Societe Union Electrique de St. Claude (France), in 1909, two turbines, each of 945 h.p. and working under a head of 23 feet, for the Saut Mortier installation. In 1912 a repeat order was given for a third unit for the above installation and the capacity being increased to 2,200 h.p. under a head of 36 feet.

Messrs. Calvet, of Barcelona (Spain), in 1911, one 240 h.p. turbine with horizontal shaft working under a head of 11 feet.

The air may also be extracted by means of a jet-pump, which has induced Messrs. Escher Wyss & Company to take up the construction of turbines which can be erected above the head race water level. In order to start the machine an artificial water level must be created by operating the jet-pump, as shown in Fig. 1.

A turbine of this type fitted with six runner wheels on one shaft is at present in course of construction, destined for Messrs. Guenther & Richter, of Wernsdorf, Germany. This turbine has an output of 1,730 h.p. when working under a head of 16½ feet.

NEW CARS FOR LONDON COMPANY.

The London & Lake Erie Railway & Transportation Company, of London, Ont., recently received from the Niles Car and Manufacturing Company two motor passenger car bodies and two trailer car bodies. These cars are of light weight, the body weighing about 21,000 lbs., and will seat 54 persons. They are built for double end operation. The arch roof and single side walls decrease the weight and cost, and increase the width of aisle and length of seats. The cars are designed to handle summer excursion traffic.

The general dimensions of the cars are as follows: Length over buffers, 49 ft. 4 ins.; length of car body, 38 ft.; length of passenger compartment, 27 ft 2 ins.; length of smoking compartment, 10 ft. 10 ins.; width over all, 8 ft. 8½ ins.; height under sills to top of roof, 9 ft.; height from track to top of roof, 11 ft. 10 ins.; distance between bolster trucks, 26 ft.; wheel base of trucks, 6 ft. 4 ins.; length of seats, 36 ins.; width of aisle, 26½ ins.

The underframe is of semi-steel with two centre sills of 6-in. steel I-beams reinforced on both sides under the platforms with ½-in. by 5-in. steel plates; two side sills of ⅝-in. by 7¾-in. steel plates between yellow pine sills; two 9-in. plate truss bolsters; two 6-in. I-needle beams; two 4-in. by 3-in. end sill angles; two ⅝-in. buffer plates; ¾-in. tie rod at each cross joist; and two 1¼-in. under-truss rods, and wooden framing. The floor is of double thickness yellow pine with waterproof tar felt between. The alternate panel and single side posts of the body are of oak with ½-in. vertical rods; single wall below windows of 1-in. tongue and groove oak gained ¼ in. over each post, finished inside for waist panel and sheathed outside with ¾-in. by 2-in. vertical poplar. The vestibules are flush with the car floor, and supported on steel centre sills. The car has 36-in. folding doors and has double steps and trap door over the opening at each side. In the trailers the body end bulkheads are omitted and iron pipe railings are placed between the step openings and the corner seats. The roof is of single arch style with concealed steel rafters. The interior finish is of oak. The ceiling is fitted with roof boards and rafters. The car trimmings are of bronze. A toilet is located in the main compartment against the smoking partition and has a dry hopper, sanitary finished and a cement floor. A water cooler is located in the alcove on the outside. The cars are fitted with 14 square-corner twin windows on each side, having stationary upper sashes, with five sections of clear glass in zinc channels so standing passengers can see out. There are three windows across the ends of the car, affording passengers an unobstructed view in either direction.

The motor cars are equipped with four Westinghouse, No. 93A, 60-h.p., 600-volt, d.c. motors, straight air brakes and Baldwin trucks. They weigh complete about 28 tons.

ASTRONOMICAL OBSERVATIONS FOR AZIMUTH ON DOMINION LAND SURVEYS.

By J. A. Macdonald.*

With the high class of instruments now supplied our Dominion land surveyors, Azimuth observations, by using Polaris, are possible at almost any time on a light, clear, day, provided the telescope is properly focused. During the summer difficulties are sometimes experienced in detecting the star, when the object glass is not sufficiently protected from the reflection of the sun's rays. The instrument makers, however, provide a ray shade to obviate this.

On every clear day the watch error is easily determined by the surveyor by the sun's transit at noon. This observation entails no delay, and is by far the safest, because an observation on a star for the same purpose might keep the surveyor late on the line, but often prove impossible later on in the day.

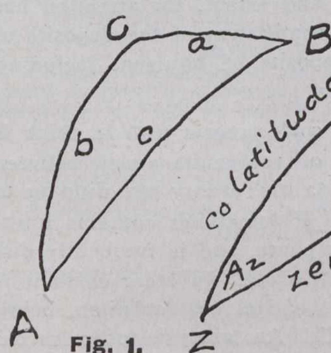


Fig. 1.

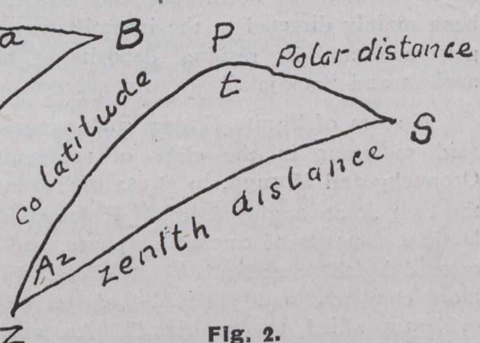


Fig. 2.

The formula recommended by the Surveyor-General's Department for the reduction of Azimuth observations in Polaris is derived as follows:

In the spherical triangle to be solved, two sides and the included angle are given. The sides are arcs equal to the co-latitude of the place of observation, and to the Polar distance of the star (Polaris).

They include the hour angle of this star at the moment of observation.

The required angle and Azimuth of Polaris is formed by the two great circles which intersect at the zenith, and of which one is the Meridian of the place.

In Fig. 1.—To prove $\tan A = \dfrac{\tan a \operatorname{cosec} b \sin c}{1 - \tan a \cot b \cos C}$

Now, $\dfrac{\sin A}{\sin a} = \dfrac{\sin C}{\sin c}$ or $\sin A \sin c = \sin C \sin a$ (1)

and $\cos a = \cos b \cos c + \sin b \sin c \cos A$,

or, $\sin c \cos A = \dfrac{\cos a - \cos b \cos c}{\sin b}$ (2)

Dividing (1) by (2) we get

$$\tan A = \frac{\sin a \sin b \sin C}{\cos a - \cos b \cos c}$$

Dividing numerator and denominator by $\cos a \sin^2 b$ we get

$$\tan A = \frac{\tan a \operatorname{cosec} b \sin C}{\dfrac{1}{\sin^2 b} - \dfrac{\cos b \cos c}{\cos a \sin^2 b}}$$

Now, $\cos c = \cos a \cos b + \sin a \sin b \cos C$

Hence,

$$\tan A = \frac{\tan a \operatorname{cosec} b \sin C}{\dfrac{1}{\sin^2 b} - \dfrac{\cos b}{\cos a \sin^2 b}\Big(\cos a \cos b + \sin a \sin b}$$

$$= \frac{\tan a \operatorname{cosec} b \sin C}{\dfrac{1}{\sin^2 b} - \dfrac{\cos a \cos^2 b}{\cos a \sin^2 b}} - \frac{\sin a \sin b \cos b \cos C}{\cos a \sin^2 b} =$$

$$= \frac{\tan a \operatorname{cosec} b \sin C}{\dfrac{1}{\sin^2 b} - \dfrac{\cos a \cos^2 b}{\cos a \sin^2 b} - \dfrac{\sin a \sin b \cos b \cos C}{\cos a \sin^2 b}}$$

$$= \frac{\tan a \operatorname{cosec} b \sin C}{\dfrac{1 - \cos^2 b}{\sin^2 b} - \tan a \cot b \cos C}$$

$$= \frac{\tan a \operatorname{cosec} b \sin C}{1 - \tan a \cot b \cos C}, \text{ since } 1 - \cos^2 b = \sin^2 b.$$

Now in the spherical triangle P Z S (Fig. 2).

P = Pole

Z = Zenith

S = Star (Polaris)

$$\tan P Z S = \frac{\tan P S \operatorname{cosec} P Z \sin Z P S}{1 - \tan P S \cot P Z \cos Z P S}$$

$$\text{or } \tan \text{Azimuth} = \frac{\tan P \sec L \sin t}{1 - \tan P \tan L \cos t}$$

where P, L and t are Polar distance, latitude and hour angle respectively.

This is the formula recommended by the manual of surveys of Dominion lands for the reduction of Azimuth observations by using Polaris, though its derivation is not shown in the manual, but it is here given in graphic form.

Surveyors are, however, at liberty to use any formula or process for reducing their observations, but as forms and tables could not be prepared for every method this formula,

$$\tan Z = \frac{\tan P.\ \sec L.\ \sin t}{1 - \tan P.\ \tan L.\ \cos t}$$

where Z. P. L. t. are Azimuth, Polar distance, latitude and hour angle respectively.

The logarithms of secant and tangent L are given in tables for the north side of every section

By means of these astronomical field tables now supplied surveyors, the observation has become very easy and simple.

The instruments necessary are a watch, keeping sidereal time, that is to say, gaining 3 minutes 56 seconds a day, and a four-inch transit theodolite, now listed by several manufacturers, so-called "Canadian Pattern." A common watch of a reputable manufacturer is good enough. The best grades keep the time for weeks and months with sufficient

* Of the Topographical Surveys Branch, Department of the Interior, Ottawa.

accuracy, the error being ascertained from time to time by a Meridian observation of the sun or star.

In the western provinces and territories the air is exceedingly transparent, and a light, star-like Sirius may be seen at any time during the day. The pole star is best seen about an hour to a half hour before dark. While there is still ample light for reading the graduation, it may also be observed in the morning.

Observation of the Pole Star for Azimuth.

The instrument must be carefully levelled. The observation is made on a section line or traverse station, which is called the reference line, the bearing of which is known with sufficient approximation for setting the instrument in the Meridian.

Set the vernier of the horizontal circle to read the bearing of the reference line, loosen the lower clamp and turn the instrument until the telescope is directed on the reference line; fasten the lower clamp and release the upper clamp. The instrument is now set to read the astronomical bearings. By setting the vernier at 360 deg., the telescope is in the Meridian.

In the example below, the vernier is set to read 180° 05′, the lower clamp released and the telescope directed on the east boundary of section 18. The telescope is set for the latitude of the pole star, shown in tables furnished the surveyor. For example, in the example the table or diagram shows a latitude of 51° 20′ corresponding to township 27. The vernier is now set to read the bearing of the star taken from the time shown by the watch. In the example it is set at 358° 19′. So set, the star is in the field, and will be seen, provided the telescope is accurately focused. The time by the watch is noted as well as the horizontal circle reading. For all Azimuth work it is essential that the observation be made in two positions of the instrument, circle right and circle left. The position of the instrument is reversed by transmitting the telescope and turning the vernier plate 180°. The first part of the observation is now repeated. The H. C. R. on the reference line is recorded, the telescope is set at the altitude of the star, the vernier at the bearing, and the field is scanned for the star. When found, the time by the watch and horizontal circle reading are again recorded.

The following example shows clearly how the observation is worked out:

Astronomical Observation.

Date—January 19, 19—, 8.45 a.m., mountain time.
Place—N.E. corner Sec. 18, Tp. 27, R. 20, W. 3rd. Mer.
Reference Line—East boundary of Sec. 18.

Face.	H.C.R. on reference line.	H.C.R. on Polaris.	Watch time.
1 Right	180° 05′	1° 21′.9	16 h. 22 m. 57 s.
2 Left	180° 03′	1° 23′.0	16 h. 25 m. 07 s.
Mean	180° 04′	1° 22′.45	16 h. 24 m. 02 s.
3 Watch correction		—	42 s.
Sidereal time			16 h. 23 m. 20 s.
4 Tabular bearing for 16 h. 20 m. and Tp. 20		1° 15′.5	
5 Difference for 3 m. 20 s............		+ 1′.1	
6 Difference for 7 townships		+ 1′.0	
7 Convergence for 2 sections		+ 2′.2	
8 Bearing of Polaris		1 19′.8	
9 H.C.R. on Polaris		1 22′.45	
10 Correction to H. C. R..............		— 2′.65	
11 H. C. R. on reference line..........		180° 04′	
12 Bearing of reference line		180° 01′.35	

The bearing is generally found to differ from the bearing by account which was 180° 05′ in this example. The difference represents the accumulated errors of the survey. It is distributed among the previous courses of the survey, according to the judgment of the surveyor.

In the observation, the watch correction was assumed to be known within one minute. This correction has to be ascertained from time to time, more or less frequently according as the watch is of a better or of an inferior grade.

The watch having been set approximately to sidereal time, its correction is ascertained by observing the meridian transit of a star or of the sun.

When it is desired to observe at a place where no line of known bearing exists, the surveyor sets his instrument in the Meridian by means of the compass for turning the instrument in the direction of the star. The magnitive declination can now be easily determined from tables, when the star can be brought into the field of the telescope.

COAL IN THE WEST INDIES.

The only locality in the West Indies where coal has been found is the island of Trinidad. There is little information as to its mode of occurrence and extent, for attention has been mainly directed to the investigation of the deposits of petroleum and its residual deposits of bitumen, including asphalt and "manjak."

A seam of lignite (brown coal) from 4 to 6 ft. thick is said to occur in the cliffs of the south coast between Oropuchy and Moruga, in strata of Tertiary age dipping to the east at an angle of 30°. It sometimes contains interlaminar deposits of calcium sulphate, and is frequently discolored by the presence of iron oxide. In other cases it is more compact, and resembles cannel coal or pitch, being evidently allied to "manjak." An analysis of a mixed sample in the Scientific and Technical Department of the Imperial Institute gave the following results:

	Per cent.
Volatile matter (including sulphur but not water)..	32.9
Fixed carbon	34.0
Water	13.7
Ash	19.4
Sulphur	5.06
Calorific value,[1] small calories	4,378
Evaporative power[2]	8.17

[1] The calorific value represents the number of grams of water raised from 0° to 1° C. by the combustion of 1 gram of the coal.

[2] The evaporative power represents the number of grams of water at 100° C. converted into steam at the same temperature by the combustion of 1 gram of the coal.

The coal burned readily with a highly luminous flame. When it was heated to drive off the volatile constituents, the residue did not cake and form coke, but left a friable mass which fell almost at once to powder. The coal is therefore of inferior quality, the percentage of fixed carbon being too low, and that of ash and sulphur too high. The amount of sulphur is no doubt largely due to the presence of calcium sulphate, which might be removed by washing. The fact that the samples were taken from the surface may be responsible for their poor quality.

The Canadian Engineer

ESTABLISHED 1893.

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T. H. HOGG, B.A.Sc. MANAGING EDITOR — A. E. JENNINGS, ADVERTISING MANAGER — P. G. CHERRY, B.A.Sc. CIRCULATION MANAGER

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The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

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CONTENTS OF THIS ISSUE.

THE JORDAN RIVER DEVELOPMENT OF THE VANCOUVER ISLAND POWER COMPANY.

The Jordan River Development of the Vancouver Island Power Company, Limited, is an exceedingly interesting one from many points of view. The plant itself is not a very large one, but the difficulties that were met with and overcome in securing the necessary data, and afterwards, in installing the plant, were exceptional.

The preliminary investigations were carried on in what was practically virgin forest, and the engineers had practically no data to hand to enable them to decide where the development should be located. The powerhouse itself is located in almost inaccessible country, and the difficulties of getting a construction plant on the ground, together with the actual construction of the plant, will, therefore, be appreciated. The first section of a description of the Jordan River Development appears in this issue of *The Canadian Engineer*. The way the necessary data was compiled, and the constructive details were worked out, reads most interestingly. The engineers in charge of this work are to be congratulated for the ingenuity and perseverance shown throughout the investigation and the actual construction.

THE INTERNATIONAL JOINT COMMISSION AND SEWAGE POLLUTION OF BOUNDARY WATERS.

As has been noted in these columns from time to time, the International Joint Commission is taking up, under instructions from the several governments, an enquiry into the pollution of international boundary waters. At the Washington session on November 18th, Secretary of State Knox directed that, "The enquiry should be confined to cases of pollution on one side of the boundary which extend to and affect the other side." This statement very much limits what was thought to be the original scope of the enquiry. It would appear from this statement that investigation of pollution would be restricted to the narrow waters of the St. Mary's River, Mackinac Strait, the St. Clair, Detroit, Niagara and St. Lawrence Rivers. Thus, the cities of the United States, which are located on the Great Lakes, and which are at present polluting lake waters, do not come within the sphere of investigation of the Commission.

It would appear that the above limited meaning of what is meant by sewage pollution will greatly impair the usefulness of the investigation. This construction is placed on the enquiry by the United States Branch of the International Joint Commission. It is not believed, however, that the Canadian Branch will assent to the above meaning. While it is true that it is highly desirable to investigate the relationship of cities, such as Buffalo and Detroit, to the question of sewage pollution, it is just as desirable that cities like Rochester and Cleveland should also come within the meaning of the enquiry.

If this investigation is to serve the best interests of Canada and the United States, it is highly desirable that the scope should be understood to include all cities and municipalities using international waters as a means of sewage disposal. With the limited construction placed upon the question, it would be impossible for the Commission to consider pollution of international boundary waters from boat traffic, and this would be a serious limitation.

EDITORIAL COMMENT.

The council of a thriving Western municipality announce that they will erect a jail and storehouse in one building at a cost of $20,000, but omit to state what preparation has been made to preserve the "long termers" during the storage period.

* * * *

The executive of the Ontario Good Roads Association announce that the annual meeting will be held on February 26th, 27th and 28th, in the Machinery Hall of the Toronto Exhibition grounds. A Good Roads exhibit, showing different classes of road-making machinery and samples of various roadbeds, will be held at the same time. This exhibit should be an added stimulus to this already very successful Association. No doubt, the different manufacturers will be interested in making the exhibit a success.

* * * *

In this issue, under "Letters to the Editor," will be found certain correspondence in connection with an editorial which appeared in our issue of November 7th on "Protection of Canal Lock Gates." Our impression was, at the time this editorial was written, that the Gowan Safety Device had been in use on gates other than Lock 24 of the Welland Canal. We are glad to note Mr. Gowan's correction. The letter from Mr. W. H. Sullivan, Superintending Engineer of the Welland Canal, corroborates Mr. Gowan's statement that the gates at Lock 24 have had some severe tests.

* * * *

In our last issue, November 21st, the City Commissioners of Edmonton advertised for sealed tenders for "Paving for 1913" for approximately 400,000 square yards of asphalt and bitulithic pavement. The Commissioners of Edmonton cannot be too highly congratulated for their progressiveness in this matter. The only sure way of getting a paving contract started early in the spring is to call for tenders in the preceding fall. Far too often paving work is just being started in September or October, with the result that the pavements are always at least a year behind. If more city engineers would follow the move of the City Commissioners of Edmonton there would be less trouble in the letting of contracts for the summer's pavements, the work would be better done, and it would be finished on time.

LETTERS TO THE EDITOR.

PROTECTION OF CANAL LOCK GATES.

Sir,—Your article in last week's issue of The Engineer re "Protection of Canal Lock Gates," is timely and appropriate, as far as the necessity for the adoption of some efficient device for the protection of lock gates against the impact of vessels is concerned.

In this article you describe the "Gowan safety device" and the "chain fender system," the former as applied on the Welland Canal, the latter to be on the Panama. While you admit the Gowan safety device has been very successful on the Welland in cases of small speed, you conclude that, from the number of accidents recently occurring, some more suitable device is necessary, and suggest the "chain fender," as to be applied on the Panama.

Admitting that the intention of your article is to be fair to both devices and in the interests of navigation, the writer must take exception to your conclusion, as it is based on a wrong idea, viz., that the gates on the Welland Canal are equipped with the Gowan safety device. This is not so.

In the description of the Gowan safety device, supplied you by Mr. J. L. Weller, now engineer-in-charge of the new Welland Ship Canal, and appearing in your issue of July 4th, 1912, the words, "as applied to the existing gates of the Welland Canal," are incorrect, and may have misled you. This device has, so far, been installed on one lock only on the Welland, viz., Lock 24, one of the most dangerous points on the canal, and has proved by three actual tests to be a decided success, not only against a light impact, as you describe, but against a vessel under full steam, as in the case of the "Harry Packer," which snapped three cables and cut an oak wale on the gate, 6 x 10, completely in two with her stem. Had the Welland Canal lock gates been equipped fully with the "Gowan safety device," the accidents you record would have in no case happened, and your article in reference would have been uncalled for.

The Engineer can get full corroboration of the above statements as to the merits of this device under actual tests from the Department of Railways and Canals, Ottawa, or by applying to W. H. Sullivan, Engineer-in-Charge, Welland Canal, St. Catharines, Ont.

It is hoped you will give this letter as full publicity as your article, to which it is a reply, said article having been copied by other papers.

Yours respectfully,

N. W. Gowan,

Inventor and patentee.

St. Catharines, Nov. 16th, 1912.

Sir,—Replying to your communication of the 19th inst., I would state that the Gowan safety device for the protection of lock gates was installed by Mr. Weller, now Engineer-in-Charge of Welland Ship Canal, on the upper gates of Lock No. 24 of the Welland Canal about two years ago.

This lock was chosen on account of its being the one where the consequences of a break would prove most serious. Until the present season no vessel collided with these gates with sufficient force to give the device a severe test.

On May 20th, 1912, the steamer "Beaverton," bound up, while locking, surged ahead with sufficient force to break a wire hawser, striking the upper gates and opening them sufficiently to admit the boat's stem into the mitre. I feel satisfied that but for the device the gates would have been carried out.

On August 16th, 1912, the steamer "Harry E. Packer" entered the lock with speed, and through some misunderstanding of signals the engineer, instead of backing up, drove the vessel full speed ahead against the gates.

Three large snubbing lines were broken, and the boat struck the right head gate, cutting a 6 in. x 12 in. oak wale through and opening it quite a distance.

The upper finger of the device supporting the left gate broke, which was, so far as can be judged, due to a flaw in the casting. The full load was thus thrown on the lower finger, which held, and prevented a very serious accident.

The injured gate, though badly twisted, was sufficiently repaired in three hours to resume navigation, and later on was replaced by a spare gate.

The device will be placed on at least five more locks this winter.

Trusting the above information covers your requirements, I remain,

Yours very truly,

W. H. Sullivan,

Superintending Engineer,
Welland Canal.

St. Catharines, Nov. 21st, 1912.

CANADIAN ENGINEERS AND DRAUGHTSMEN.

Sir,—The article on the above subject in your issue for the 14th inst., while offering some good suggestions, makes some rather amazing statements. The writer attributes the scarcity of capable draughtsmen in Canada chiefly to the large proportion of people whose parents were "nothing but farmers." In other words, boys who hail from the country are thereby partly incapacitated from thoroughly learning engineering, and, presumably, any profession. I quite disagree with this. History and biographies show again and again that the real genius comes from the country and seldom from the city, and in no sphere of life is this more true than in engineering. Telford, Watt, Stephenson, and a great many other engineers in our own day came straight from the land. Practically all the great authors and poets owe their genius to mother earth. Most of the great statesmen, Gladstone excepted, were country bred. Everyone knows the story of Abraham Lincoln.

To my mind, the reason why the Canadian-born draughtsman, as a rule, has not had the experience, and does not possess the initiative of his competitors, is that competition in a new country like Canada is not keen enough. In Britain, no one without shop experience could get a job as draughtsman. To a large extent, drawing offices in Canada seem to be recruited from a few college students and many tracers, instead of from young men who have just completed a shop apprenticeship. On the latter point I quite agree with the author of your article. One reason, I consider, why young Canadians do not stay long enough at the drawing-board to acquire thorough experience is the fact that in many offices a draughtsman's lot is a dog's life of push and drive. The man quietly makes up his mind to get out at the first opportunity and into some opening where there is a little more mutual trust and confidence.

As to the suggested increase in technical schools, I maintain that this has been overdone in England to such an extent that the market value of a knowledge of mechanical engineering design has been reduced to 35 shillings a week ($8.40). My experience has been that the quickest draughtsmen are often those who have not a superabundance of technical knowledge, as they do not stop at every turn to worry themselves about theoretical considerations. This statement will probably meet with opposition.

Without trespassing further on your valuable space, I shall conclude with a short reference to the much-maligned premium apprentice system. Don't pay a premium if you can help it, of course. Personally, I owe my practical training to this system, as without it I could not have got a start in an engineering works, having no friends or relatives who were ever connected with the business. In Europe, at all events, the premium apprentice is the only form in which new blood comes into a concern. Almost all the mechanical engineers of the British railways are from the ranks of premium apprentices.

C. Oldrieve Thomas.

Montreal, Nov. 20th, 1912.

25-CYCLE CURRENT FOR LIGHT.

Sir,—It has occurred to me to wonder if any one has considered the probable effect on eyesight of the disagreeable flicker noticed with lights deriving power from Hydro-Electric System. This would appear to be due to the fact that they are using 25-cycle alternating current. I have not seen any explanation as to why the 25-cycle current was chosen, as it must surely have occurred to the devisers of the system that this was approaching very closely to the limits of persistence of vision so that a sensitive eye readily notes the flicker due to the comparatively slow alternation of polarity. It is a point that deserves consideration by expert oculists.

Yours truly,

J. EDW. MAYBEE,
Ridout & Maybee, 59 Yongs St.,
Toronto.

Nov. 22nd, 1912.

PRESERVATION OF TIES.

Sir,—Your issue of November 14th contains an article written by Mr. E. A. Sterling on "The Development and Status of Wood Preserving Industry in America," in which he gives a summary of the various processes of treating methods now in use in this country. He divides the different kinds of treatment into three classes, namely, (1) high artificial pressure process, (2) atmospheric pressure process, and (3) low artificial pressure process. Each of these is again sub-divided into two classes, namely, (1) "full-cell" and (2) "empty-cell." This is quite a foxey classification, but it is inconsistent and is not entirely in accord with the facts. In the first place he omits to mention in his summary the "boiling in oil process," which is used to a considerable extent in the West, and we would be curious to know in what class he would include that process. Again, he does not describe how "full-cell" and "empty-cell" treatment is secured or performed with "low artificial pressure process," as he does for all the others mentioned in his schedule, and leaves one to guess as to how it is accomplished. Nor does he make clear what he means by "high artificial pressure" and "low artificial pressure." Is it not true that the pressure in the impregnating cylinder may be anywhere from one pound to 250 pounds, or even more? Therefore, wherein is the distinction between the two processes? If there is any, when and by whom was the line of demarcation established?

In regard to the so-called "full-cell" and "empty-cell" process, I desire to repeat here what I have often expressed orally and in writing, that there can be no such distinction between different treating processes, and that these words were coined by exploiters of patented creosote processes to humbug and bamboozle the uninitiated. These so-called "empty-cell" processes are nothing more than "partial dose" processes, injecting only a limited quantity of creosote oil into the timber, and in many instances the proper seasoning and preparation of the ties before treating, which is so essential for good work, are ignored.

I would summarize the methods in use in this country at the present, as follows:

Artificial Pressure Processes.

Full Dose.—Impregnation done in closed cylinders. Preservatives injected in the wood to total refusal, after the wood is put into a receptive condition by air seasoning, or boiling in steam or oil. Preservatives mostly used are creosote oil, zinc chloride, crude oil and other chemicals and solutions. Penetration and diffusion as thorough as the condition of the wood and process of treatment will admit.

Partial Dose.—Impregnation done in closed cylinders. Duration and amount of pressure regulated so as to inject a limited quantity of preservative into the wood. Creosote being the only preservative used in this process. Penetration usually scant except in sapwood and the variation in absorption in individual ties is very large.

Atmospheric Pressure Processes.

Light Dose.—Impregnation done in open tanks. Preservatives usually creosote oil, crude oil, or carbolineum. Quantity absorbed depending upon the temperature and nature of solution, character and condition of the wood. Treatment only superficial.

The Lowry and the Rueping processes come within the category of "partial dose, artificial pressure process."

Mr. Sterling states that the present tendencies are towards lighter impregnation with creosote and that no less than sixteen plants use a light impregnation creosote process. While not specifically so stated, the impression left on my mind after reading this article, and I think on that of most readers, is that it is economical to treat ties with a light dose of creosote. We do not believe these light treatments are economical, and possibly some of the railroad companies treating their ties with light doses of creosote are making a great mistake.

Treating railroad ties with light doses of creosote oil has shown emphatically by experience, a very unwise thing to do. For motives of economy some of the French railways undertook to reduce the quantity of oil injected into their ties, from full dose to partial dose, and met with unfavorable results. Why should we not profit by past experience and treat ties to refusal, instead of repeating these mistakes

In France where the creosoting of ties is an old industry, heavy treatment has been the rule, forcing into the timber all of the creosote that it would take. In England, also, the creosoting of railroad ties is an old industry, but, on the average, a somewhat smaller quantity of creosote per unit volume of timber has been used than was common practice in France. In comparisons of the practical results obtained in the two countries it has always been reported that the life obtained from creosoted ties in France was longer than in England, purely and simply because of the larger amount of material used per unit of the treated timber. If the long-standing results of experience in these countries have been correctly represented, and if any significance attaches to them, we fail to see the logic in much of the supposedly experimental work that has been done in this country. If the life of the timber depends upon the amount of preservative injected, as long-time experience seems to teach, then skimping the material might be expected to result as skimping usually does in other engineering work, no matter under what name or disguise the art is practised. The old adage, "Anything worth doing at all is worth doing well," is eminently fitting in the treatment of ties and timber.

W. F. GOLTRA, President,
The W. F. Goltra Tie Company.

Cleveland, Ohio, Nov. 22nd, 1912.

ELECTRICITY AND REINFORCED CONCRETE.

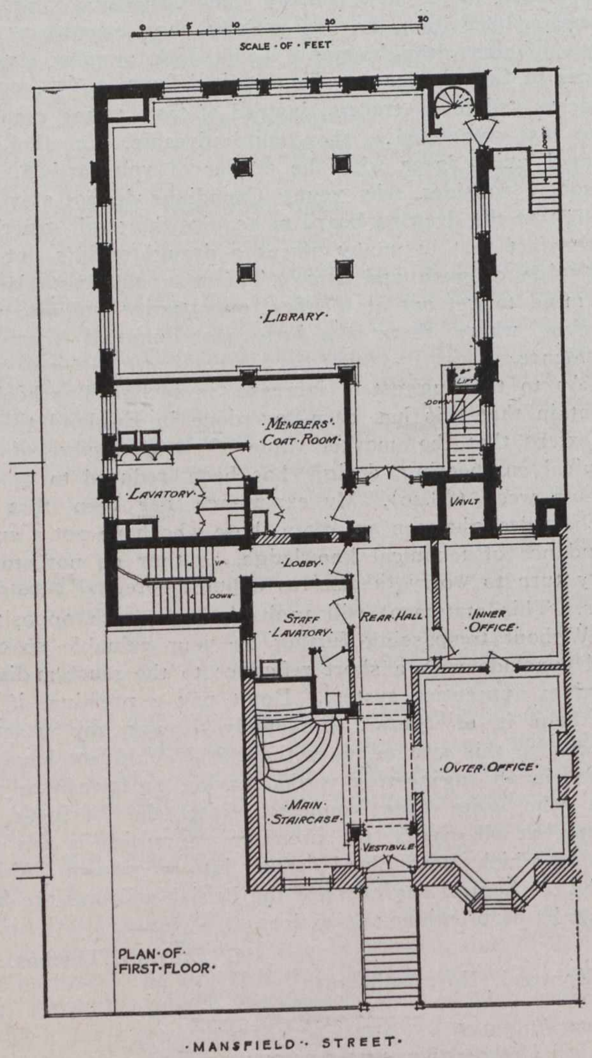
A description and data of tests on the action of electricity (stray direct currents) on reinforced concrete made at the Technical School at Darmstadt, Germany, are given in a recent issue of Le Génie Civil, and abstracted in the Journal of the American Society of Mechanical Engineers. With concrete blocks placed in air on a layer of moist sand, or in sweet water, and subjected to the passage of a current of 0.1 ampere at 140 volts, fissures appeared after a period of from 50 to 110 days, the location of the fissures depending entirely on the position of the anode; in blocks placed in salt water they appeared at the end of from 20 to 70 days, and the concrete was colored in the neighborhood of the fissures first greenish gray (ferrous oxide), and after some exposure in the air, brown (ferric oxide). Fissures appeared in blocks immersed in chalk water in about the same time. A series of experiments led to the belief that these fissures were produced not by an evolution of gases, but by a thickening of the iron anode enclosed in the concrete, owing to superficial oxidation. By further tests it was found that the resistance of the reinforcing members to being torn out is increased by the action of the current, which may be explained by the formation of a layer of oxide adhering to the concrete more strongly than the original clean line.

THE NEW HOME OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

As is well known, the Canadian Society of Civil Engineers sold their property at 413 Dorchester Street, Montreal, recently, where their rooms have been located for some time, and have acquired a new location at 176 Mansfield Street, Montreal.

On this location they are building new rooms which, it is expected, will be ready for occupancy for the annual meeting.

The building is very commodious, and is designed to secure the maximum advantage of the available space. The old house which stood on the lot at the time of its purchase has been remodelled to suit office requirements, and a new two-story building is now in process of construction in the rear. The new structure will provide an auditorium, giving seating accommodation for 225 persons. A library, reading rooms, and dressing rooms are also provided. In the basement is located the heating and boiler equipment, and a



First Floor Plan of New Premises of the Canadian Society of Civil Engineers.

very large bookstack room, affording adequate storage accommodation for unbound engineering literature not suitable for the library shelves and for the surplus stock of publications of the society. The plan of the first floor, as seen in the cut, shows the offices, cloak rooms, and the library located there. On the second floor is located the reading room, the board room and the lecture room. The attic floor is laid out to provide two bedrooms, a living room, kitchen, store-room and bath-room.

The cost of the lot and the old building amounted to $47,100, and the contracts for alterations to the old building and construction of the new building to $36,449, making a total expenditure of $83,549. This amount will have to be supplemented to a small extent by the purchase of additional furniture and minor contingencies.

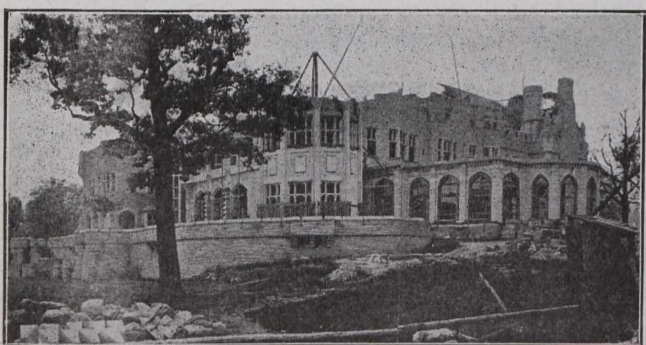
Building operations are now well under way, and it is expected that the premises will be ready for occupation on January 1st next.

A STEEL, STONE AND CONCRETE RESIDENCE.

The illustration depicts the exterior of a residence that is possibly without a rival on this side of the Atlantic. It is situated on Wells Hill, overlooking the city of Toronto, and is being constructed for Sir Henry Pellatt.

The exterior undoubtedly is a good representation of an ancient baronial stronghold and is very similar to structures now standing in various parts of Europe, but the interior at once shows several marked departures in construction methods from those generally employed in residence building.

The main entrance faces toward the south, but as this is inaccessible to carriages and automobiles an entrance for these has been constructed in the rear of the building to which a long winding driveway leads; this entrance opens into the main reception hall, which is a very large room, and will contain the base of the grand staircase and a pipe organ with a balcony for an orchestra. A library to the east and a dining room to the west occupy the entire front of the building and from a hallway passing by the library entrance is gained to the palm house and swimming pool; practically all the eastern section of the house is taken up by the latter.



New Residence for Sir Henry Pellatt, Toronto.

An underground tunnel has been constructed whereby the stables may be reached without going outdoors; the entrance to the tunnel from the residence is reached from below the base of the main staircase.

The method of interior construction is entirely along the lines adopted in the erection of modern office buildings. Many steel beams are used and the floors are all of interlocking tiles covered with concrete and the various pipes used for steam heating and electrical insulation.

When the structure is completed and the floral decorations are properly arranged it will be a handsome addition to the buildings and architectural interests of Toronto.

The architect for this work is Mr. E. J. Lennox, Toronto.

GRADE ELIMINATION AND RAILROAD BRIDGES.*

By G. H. Tinker.

I have been asked to make a few remarks upon some of the details of construction in connection with the design of grade elimination and railroad bridges. This subject has been studied by railroad employees for a number of years. From experience with the early bridges, there have been two or three points developed which it seems necessary to consider in the design of such structures. Some of the early bridges which carry trains over the street are quite noisy and are objectionable on that account. If any one will visit Lakewood and stand under Clifton Boulevard bridge, he will understand what I mean. The rails rest directly upon the floor plate, held down by clips, and every time a train goes across, it produces a roaring sound which can be heard for a long distance; in fact, it is hardly possible to hear anything else while the train is on the bridge. It seems desirable to avoid this objectionable roaring, and considerable study has been put upon that point.

To determine how the noise could be best reduced, bridges of various types in several cities have been observed with that point in mind. In the city of Pittsburg, near the Pennsylvania station, there are two bridges which carry the Pennsylvania tracks across Penn Avenue and Tenth Street, and it is remarkable how little noise can be heard from a train crossing these bridges. When the reason is sought, it is, at first, difficult to see. However, on both bridges there is a deep bed of ballast which carries the track, so that the effect is an ordinary roadbed crossing the street by a bridge.

In the city of Chicago, there are a number of bridges which are apparently of similar construction, and yet the noise is quite pronounced. It is probable that there is not very much ballast upon the deck of these bridges, and that fact has apparently considerable effect upon the amount of noise produced. There is also a great deal of noise produced by the passage of street cars underneath the bridges, and in the case of some bridges the street cars make a great deal more noise than the railroad trains do. Where the beams forming the floor of the bridge are exposed below, forming air pockets between them, the passage of the car sets up a reverberation. There is a similar reverberation noticeable in a through girder bridge. The sound seems to rebound from one girder to the other, back and forth, until it produces a continuous roar.

It is also noticed that where the floor of the bridge is heavy and there is considerable concrete, the noise is much less. At the Detroit Avenue bridge over the Nickel Plate tracks in Cleveland, the bridge carries the roadway with the street car tracks across the railroad. The beams are exposed below, but they are covered with concrete to a thickness of some two inches on all sides. There is a sand and brick pavement on top of the concrete slab, and the street car tracks are carried upon steel ties which rest directly upon the beams. There is a slight reverberation noticeable from the passage of street cars over that bridge, but the noise is not objectionable.

Following out this line of investigation, the observations seem to indicate that if a bridge be constructed with considerable depth of ballast that the vibration of the rails and the parts of the bridge would be reduced. And, further, that if a smooth under-surface of the floor is obtained that there will be very little opportunity for a reverberation underneath the bridge. This is very well illustrated by the present Euclid Avenue bridge on the Nickel Plate Railroad.

* Paper read before the Cleveland Engineering Society

The noise from the passage of trains there is very slight. A person may stand under the bridge and hear ordinary conversation with ease while a train is passing. The space between the beams is filled with concrete, producing a smooth under-surface, and there is about two feet of ballast on top of the slab which carries an ordinary roadbed. So, we think that the reduction of noise is accomplished by attention to these details of construction.

Another point which has caused a great deal of thought is the nuisance from the dripping of water through the bridge floor upon the street below. This is objectionable even when the amount of water passing is quite small, because the water passing through ballast, trickling down through the interstices of the floor slab collects various substances such as lime, grease and iron rust, which, dripping upon passers-by, may ruin their clothes. Therefore, it has become necessary, and is required by ordinance in some cases, that bridge floors should be waterproof.

A great deal of study has been put upon the subject of waterproofing masonry, and especially the waterproofing of bridge floors, which seems to be one of the principle things requiring waterproofing. The American Railway Engineering Association through its Masonry Committee, has had this subject under investigation. The committee has made three progress reports, but has not, as yet, published any definite conclusions. The committee has found this to be a large subject, and one upon which almost any proposition may be proved if the contradictory instances are ignored.

There are several companies who are exploiting various waterproofing compositions. They have had a large growth in the last few years, partly because of the necessity for waterproofing structures of this kind. There are many substances which are more or less impervious to water. In fact, nearly every substance is impervious to a degree; some very slightly, some very much so. A wooden plank offers a certain resistance to the passage of water; so does a slab of stone. Under some conditions considerable water will pass through either. Various substances of a hydrocarbon composition—asphalt, coal tar and petroleum products—seem to be quite impervious to water under certain conditions. Many substances are on the market for incorporation with the sand and cement to make impervious concrete. The theory is that these substances make the concrete so dense that water cannot percolate. Extravagant claims are made for some of these materials. Some engineers believe that for the waterproofing of masonry—and masonry now-a-days means concrete—about the best thing is concrete. The accepted method of waterproofing a concrete slab in a bridge floor is to place upon it a layer of ½-inch to 2-inch thickness of some of the asphalt, coal tar or petroleum product gums, with which may or may not be included several layers of burlap or felt paper. Now, a small surface covered with these substances will hold water indefinitely, but when you spread them over a large expanse of bridge floor, there are other difficulties to be met, and the greatest of these is the expansion and contraction from temperature. Asphalt itself, if its condition remains unchanged, is quite impervious to water, but if it contracts through cold, and cracks, the water will pass through the crack. It takes a very small crack to produce a leak which is objectionable in a bridge floor, and therefore it is necessary to have a substance which will expand and contract with the slab and not crack. This leads to the other extreme, that is, a substance so soft that when it becomes warm it will run. There are bridge floors in Chicago which leak asphalt. It is therefore clear that it is not a simple subject, and for any man to guarantee off-hand that any particular waterproofing composition will make a watertight bridge floor is rather hazardous. It is true, instances may be found of bridge floors which are apparently watertight, but there are more instances where this is not true. I think I may say that a well built slab of concrete is fully as impervious as a poorly built slab with any style of waterproofing.

In connection with the above method of waterproofing bridge floors, the asphalt, coal tar or petroleum products used require protection against abrasion and damage from external causes. This requires a still greater thickness. Many bridge floors have been built with a protection of brick on top of the asphalt. They have been fairly successful from a waterproofing standpoint, but the finished waterproofing adds in the neighborhood of 6 inches additional thickness to the bridge floor, and it is the opinion of a good many that that 6 inches could be better utilized by placing 6 inches of concrete on the floor.

In the bridges recently built in Cleveland by the Nickel Plate no foreign waterproofing substance has been used. An attempt has been made to construct a concrete slab which would be in itself as nearly waterproof as it is practicable or desirable to make. This has proved satisfactory. When the Cedar Avenue bridge floor was built, the ends of the bridge were dammed up, the trough so formed was filled with water and allowed to stand for several days. No water whatever came through at any point of the slab. A little water ran through the dam and down over the back wall, and seeped through the joint between the bridge seat and the floor slab. At the centre bent there is a drainage system provided to carry what water might percolate through at that point down to the gutters. Through some slight defect in the formation of this drainage some water seeped through there and dampened the concrete, but at no point of the bridge did any water drip.

One of the most essential things in the successful waterproofing of a floor slab is to get rid, in the most direct manner, of all the water that accumulates. That means that a drainage system must be provided which will be ample to take care of all of the water which can be collected upon the bridge floor. This sounds simple, but it is quite difficult. These drainage systems have to be carried some distance; they have to pass around a great many angles and eventually reach the level of the street gutters or of the sewer. At the Euclid Avenue bridge such a drainage system is in place. When the bridge was first completed it was discovered that at some point between the bridge floor and the sewer the drain pipe was clogged, with the result that the water did not run away, but stood in the drainage gutter and eventually soaked through the concrete. This illustrates the care and painstaking attention to detail necessary to secure the desired results. This pipe has since been cleaned out so that water runs away readily.

The essential points in constructing a watertight floor slab are: Dense concrete—the denser the more impervious; intelligent study and design in the location of expansion joints the provision of an ample drainage system; careful workmanship and constant supervision during construction.

Another point which has developed from experience with bridges over the tracks where the under-clearance is low, is that the blast from the engine has a very detrimental effect on the structure overhead. In the city of Chicago it has been determined that where the clearance is about 18 feet the steel will be worn away by the engine blast at the rate of about ¼ inch in ten years. That means that the flange of an I-beam would be so much deteriorated in ten years that the beam would have to be replaced. This has occurred in some instances in Chicago.

At the Detroit Avenue crossing of the Nickel Plate the clearance is 16 feet 3 inches, which is the general rule in

Cleveland. The I-beams in this case are covered with concrete to a thickness of 1½ to 2 inches; it was found in the course of a few years that the engine blast eroded the concrete, so that in about five years there is a bare streak of steel over the centre of the track. At the Adelbert Road and Cornell Road bridges it was decided to place cast iron plates immediately over the centre of the track. These smoke plates are about ½ inch thick. The engine blast will not be as destructive as upon steel, the cast iron being harder and when the plates are destroyed they can be replaced with little trouble and expense. In some cities a wood plank has been used for this same purpose. In the city of Philadelphia, the Philadelphia & Reading Railroad placed a wooden ceiling under their steel bridges. These gave fair satisfaction for several years.

Our experience is that a concrete covering will be satisfactory for a few years, but where the head room is low, as is apt to be the case in cities, that it will not protect the steel permanently. It must then be replaced, and it is well known that to repair an old, worn surface of concrete is likely to prove a difficult and costly operation.

One point in connection with the subject of co-operation. In some cities, there has been a tendency to design the work of grade elimination at the least possible expense. That means the lowest height for retaining walls, the least difference between the grade of the railroad and the grade of the street and the least thickness for bridge floors. This is unfortunate. While it is true that a bridge floor may be built quite thin, it is not satisfactory; it leads to the objectionable designs which I mentioned. Wherever the bridge floor consists of simply I-beams and steel plate, which is about as thin as a bridge floor can be made, there will be noise and leakage. In order to reduce the noise to a minimum, to reduce leakage to a minimum, it is necessary to have a reasonably thick bridge floor. In recent designs in the city of Cleveland about 4 to 4½ feet has been adopted. With this thickness a very satisfactory floor can be made, and it is believed that the additional expense due to the increased height and length of approaches is offset by the greater length of the life of the structure, and by the greater satisfaction which accrues from its use.

AMERICAN ROAD BUILDERS' ASSOCIATION.

Plans for the Third American Good Roads Congress under the auspices of the American Road Builders' Association, which will open at Music Hall, Cincinnati, Ohio, Tuesday, December 3, are practically complete. Reports from the officers of the association and the several committees charged with the work of preparing the programme, arranging for the allotment of exhibition space and the entertainment of visitors, etc., indicate that this congress will surpass in interest and actual value to the paving and road building industry any previous meeting ever held.

The exhibit of the United States Office of Public Roads will consist of models of modern roads of different types and historic models showing the evolution of road building from ancient times to the present. The exhibits of the states and cities will comprise maps, charts and photographs showing various methods of building roads and streets, models of the different kinds of work, testing machinery, samples of materials, etc. The exhibits of the engineering schools will consist of maps, drawings, diagrams, photographs, charts and outlines of the engineering courses, as carried on in the several institutions.

The tentative programme which will be carried out practically as prepared, with a few minor changes and additions follows:

Tuesday, December 3.

8.30 to 11 a.m.—Registration of delegates at convention headquarters, Music Hall.

11 a.m.—Congress called to order by the president. Address of welcome on behalf of the State of Ohio. Address of welcome on behalf of the city of Cincinnati. Address of welcome of behalf of Hamilton County. Address of welcome on behalf of the Cincinnati Chamber of Commerce. Response on behalf of the American Road Builders' Association. Response on behalf of visiting state officials. Re-Response on behalf of visiting city officials. Response on behalf of visitors from other countries. Appointment of committees.

2.30 p.m.—Opening address by the president of the American Road Builders' Association, Nelson P. Lewis. "The Organization of a Highway Department": (a) For a State, by Major W. W. Crosby, consulting engineer, Baltimore, Md.; (b) For a large city, by Wm. H. Connell, chief of the Bureau of Highways and Street Cleaning, Philadelphia, Pa.; (c) For county and township, by A. N. Johnson, state highway engineer of Illinois. Discussion to be opened by James Macdonald, state highway commissioner of Connecticut. "The Development of a Plan for a State Road System," by James R. Marker, state highway commissioner, of Ohio. Discussion to be opened by Col. E. A. Stevens state highway commissioner of New Jersey.

Wednesday, December 4.

10 a.m.—"Bituminous Pavements for City Use," by George W. Tilson, consulting engineer to the Borough of Brooklyn, New York City. Discussion. "Wood Block Pavements Laid by Day's Labor," by Ellis R. Dutton, assistant city engineer of Minneapolis, Minn. Discussion to be opened by H. W. Klausmann, city engineer of Indianapolis, Ind. "Cuts in Newly Paved Streets," by H. M. Waite, city engineer of Cincinnati, Ohio. Discussion.

2 p.m.—"The Contractor's Point of View," by Hugh Murphy, contractor for public works, Omaha, Neb. Discussion to be opened by S. D. Foster, chief engineer, State Highway Department, Pennsylvania. "Plant Equipment," by F. E. Ellis, manager, Essex Trap Rock and Construction Company, Peabody, Mass. Discussion.

8.30 p.m.—The visiting delegates will be the guests of the citizens of Cincinnati.

Thursday, December 5.

10 a.m.—"Some Features of Macadam Construction," by T. R. Agg, road engineer, Illinois State Highway Commission. Discussion to be opened by R. A. Meeker, state highway engineer of New Jersey. "Earth and Gravel Roads," by Robert C. Terrell, commissioner of public roads of Kentucky. Discussion to be opened by Robert J. Potts, College Station, Texas. "Highway Bridges and Culverts," by W. A. McLean, engineer of highways province of Ontario, Canada. Discussion to be opened by A. W. Dean, chief engineer, Massachusetts Highway Commission.

2 p.m.—"The Economics of Highway Construction," by Clifford Richardson, consulting engineer, New York City. Discussion. "Traffic Census as a Preliminary to Road Improvement," by Col. Wm. D. Sohier, chairman, Massachusetts Highway Commission. Discussion to be opened by Prof. A. H. Blanchard, Columbia University, New York City. "The Laying of 104 Miles of Smooth Road Surface in One Borough in Five Months," by G. Howland Leavitt, superintendent of highways, Borough of Queens, New York City.

Friday, December 6.

10 a.m.—This session of the convention will be devoted to topical discussions. The particular subjects to be discussed will be determined by vote of the delegates. Ballots con-

taining a list of questions will be distributed at the first session and delegates will be requested to indicate their choice. The speakers selected to open the discussions will be allowed ten minutes and other speakers five minutes. This promises to be one of the most interesting and profitable sessions of the convention.

2 p.m.—Unfinished business. Report of the Committee on Resolutions. Meetings of members of the American Road Builders' Association; selection of Nominating Committee.

List of Questions from Which Subjects for Topical Discussion are to be Selected.

1. Small blocks, natural or artificial, for country roads.
2. Convict labor on road work.
3. Correction of alignment and grade in existing highways.
4. Care of the roadside, including tree planting and removal of unsightly objects.
5. Division of expense of road improvement.
6. Unit price vs. lump sum contracts.

ANNUAL REPORT OF THE CANADIAN NORTHERN.

The gross earnings of the Canadian Northern Railway for the year ended June 30th, 1912, as shown in the company's annual report, amounted to $20,860,093. Working expenses were $14,979,048. The net earnings are given as $5,881,045, and the net surplus was $575,396. An increase of $4,499,381, or 27.50 per cent., is thus shown in the gross earnings, while net earnings are $890,698, or 17.85 per cent. greater than the preceding year. The working expenses were 73.82 per cent. of the gross earnings proper, and 71.81 per cent., including taxes, of the gross earnings from all sources, compared with 72.59 per cent. and 69.50 per cent. respectively last year. During the year over 586 miles of newly constructed tracks were added to the system, the average mileage operated being 3,888 miles.

The detailed report follows:—

Gross earnings—	
From passenger traffic	$ 3,434,140.81
From freight traffic	15,567,998.17
From express, mail, telegraph, dining and sleeping cars, interest and profits from elevators and other subsidiary companies and investments	1,857,954.65
	$20,860,093.63
Working expenses (including taxes, &c.)	$14,979,048.52
Net earnings	$ 5,881,045.11
Deduct—	
Fixed charges (per statement, page 17)	4,630,844.12
Surplus	$ 1,250,200.99
From this deduct interest at 5% per annum paid on income charge convertible debenture stock outstanding	674,804.11
Net surplus for the year	$ 575,396.88

An increase of 120 per cent. in the total bulk of commercial coal carried is also remarkable, the figures being 804,803 tons moved this year, compared with 370,161 tons for the previous twelve months. This increase is indicative of the growth of the coal mining industry in Western Canada, which, upon the completion of the extensions now being constructed in the larger coal areas, will receive an even greater stimulus. There is also a further indication of the prosperous extension of the cities, towns and settlements along the lines, as shown by the increase of 48 per cent. over last year in the amount of building materials carried by the railway during the year.

Land sales during the year were 55,111 acres for $836,084.37, an average of $15.17 per acre, compared with 279,151 acres for $3,345,498.73, an average of $12.00 per acre, the preceding year. The reduction in sales is substantial, but the directors, recognizing that the value of productive acreages in Western Canada is assured, and being desirous of, as far as possible, selling to settlers only, have not pressed the sale of lands. On the other hand, they have adopted an agressive policy of colonizing the free lands offered by the Dominion Government in territories adjacent to the railway. Two million four hundred and seventy-nine thousand acres of these lands were entered upon by settlers during the year, of whom a largely increased number were a most desirable class of British emigrants.

The operation of the Royal Line of steamships continue to vindicate the wisdom of engaging in the Atlantic trade. The increasing popularity of the route emphasizes the necessity for extending the service so that the company may take the full benefit of the business controlled by its organization.

Great progress has been made in the construction of the transcontinental line of the Canadian Northern system, which it is hoped will be completed by the end of 1913; the line through British Columbia to connect the western lines with tidewater at the Pacific Coast is advancing rapidly. In addition to a very fortunate advantage of easy gradients the location of the line enters without competition into a large territory, the physical characteristics of which will attract a very desirable class of settlers. The line will also give access to an hitherto unknown section of the Canadian Alps, of which the scenic attractions are such as will divert a large volume of the transcontinental tourist traffic to the route.

The work of linking up the lines in Western Canada with the railways of the Canadian Northern system in the eastern provinces is making satisfactory progress, having regard to weather and other conditions. The resources of the country opened up by this line will be productive of great traffic advantages. Capital is only awaiting the completion of these transportation facilities before entering upon the development of iron and other mineral deposits, extensive pulpwood and timber areas. In addition to the tonnage assured from this industrial development, there are the traffic advantages which will accrue from the agricultural development of the great clay belt of Northern Ontario, through which the railway will pass for a distance of three hundred and fifty miles. Experienced officers who have carried out explorations of the entire area estimate that the industrial and agricultural resources of this territory will attract and support a population of over two million of people.

During the year another section of the Canadian Northern Ontario Railway was opened for traffic, but the directors regret that owing to adverse weather and other conditions the completion of the line between Ottawa and Toronto has been delayed. The work is, however, progressing, and it is hoped in a short time to establish a through service connecting Toronto with Ottawa, Montreal and Quebec. The pulp and paper industries in Northern Quebec are expanding quite satisfactorily, the traffic advantages of which chiefly accrue to railways operated under Canadian Northern control in Quebec.

In conclusion, Sir William Mackenzie refers to the numerous prominent men who have recently visited Canada, stating that personal and unbiased examination of the actual and potential resources of the Dominion will result in still greater confidence in the future of Canada and the close cooperation in her development.

THE NEW OFFICES OF THE BANK OF TORONTO.

By Lyman B. Jackes.

Visitors to the larger and older Canadian cities must be at once impressed with the idea that the architecture of the newer structures is changing. Not only with the mode of construction and the use of steel and concrete, but in the design itself, and the expenditure of vast sums of money for no other purpose than the cultivation of the aesthetic. The new wing of the provincial parliament buildings may be taken for an example. Here the new adjoins the old with a short corridor between. The old is of the most inflammable construction; wooden floors and plaster walls with oak decoration and finish. The new is of fireproof construction; tile floors, marble walls and wainscoting, and metal covered doors that shut off various sections of the new portion. Over the new entrance to the building an elaborate stone cutting has been made representing the arms of the province and in every way the beauty of the new section outclasses anything that the old may show.

Fig. 1.—New Bank of Toronto Building.

Another example may be seen in the immediate vicinity of King and Bay Streets. A few months ago this was a corner almost a disgrace to the business section of the city with old tumble-down buildings (some mere shacks that had survived from the old days) devoted to small businesses such as the manufacture of keys (retail) and lunch rooms. To-day that corner will hold its own in architectural beauties with any similar block on the North American continent; but, it is to the latest addition to the section, the new offices of the Bank of Toronto, to which we direct tht attention of our readers.

This bank has for a number of years owned the property at the southwest corner of King and Bay Streets, with the object of erecting a new head office, but declined for many years to take a forward step until the character of the neighboring buildings could be more definitely learned. When this became suddenly the commercial centre of the city the bank announced that they would erect a million-dollar office building on their site.

It was at first expected that this would involve the erection of a sky-scraper, but a further announcement was made that the building would be but one and a half stories in height, and that the sum of one million dollars would cover the building expenses only and did not include the value of the land.

Million-dollar buildings were not a novelty to Torontonians, but the associations always accompanying such a thought were of magnitude and did not include anything of the artistic. As the new bank is rapidly nearing completion and the exterior false work is being cleared away there comes into view a building that rivals any temple ever erected by the ancients, and will be looked upon with pride by the passers-by as well as the bank directors.

The King and Bay Street facades, as may be seen from an examination of Fig. 1, is composed almost entirely of circular pilasters surmounted with a cap in the Greek Corinthian Order; there are eleven columns on the Bay Street side and ten on the King Street front.

All the exterior stone work is of Tennessee marble and practically all the carving was done after the stone had been placed in position. The carving was done with the aid of chisels driven by compressed air, the plant for supplying the air is illustrated in Fig. 2.

The interior decorations and finish will consist of polished marble stone ornaments and bronze work. The double row of windows shown in Fig. 1 would give a passer the idea that two floors were represented, but such is not the case, the public banking room extends right up to the ornaments capping the columns. The banking room ceiling, as examined from below, will show a plate of heavy, semi-transparent glassware, which shows through an elaborate pattern cast in the bronze. This bronze work is to slope upward from a wall of polished marble and will support various decorations and figures and then form a screen to allow the light filtring through the glass to reach the desks below. The weight of this metal will be enormous.

A beautiful stairway on the northern side of the public office leads to the private office which cannot be seen from the street or from below; these are placed back of the upper railing shown in Fig. 1., surmounting the abutment. The windows and doors of the private offices open onto a hallway, the outer wall of which forms the walls of a roof garden that utilizes the semi-transparent glass as a floor.

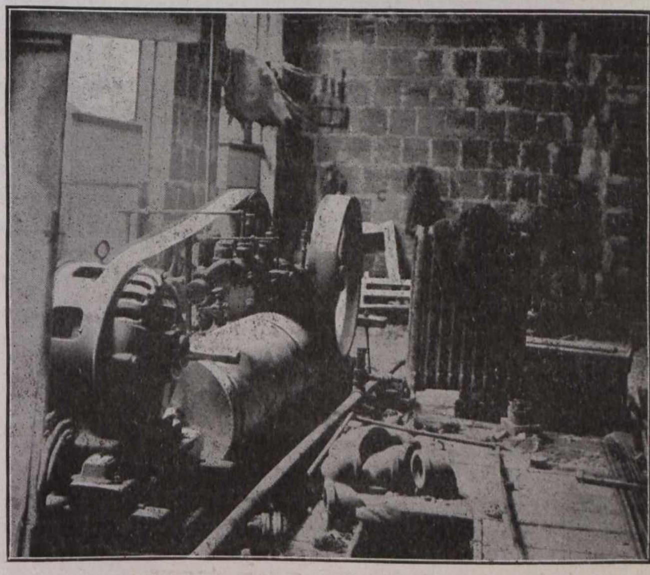


Fig 2.—Air Compressor Plant.

Taking the building as an entirety it is a novelty from the archtectural standpoint and a handsome addition to the buildings of Toronto.

Messrs. Henry Hope and Sons, Limited, 45 King Street West, Toronto, have furnished the steel frame and casement work for the windows. The lower windows will have a height of 21 feet and will be divided into two sections by a bronze panel.

Messrs. Carrère and Hastings and Eustace G. Bird, Traders Bank Building, Toronto, are the architects.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

METALLOGRAPHY OF IRON AND STEEL.

Sir,—In his kind and able review of my book which appeared in your issue for November, 1912, the reviewer expresses some astonishment that I should deal with the equilibrium diagram of iron and steel and with the phase rule at the end of the book instead of at the beginning. I am well aware that many teachers of metallography—probably the great majority of them—begin with a description of the diagram and of the phase rule as, in their opinion, the most logical and satisfactory course to follow. After some fifteen years of teaching I have come to the very opposite conclusion, namely, that it is better to postpone the study of the diagram and of the phase rule until the end of the course, and I hoped that my book would have demonstrated to the readers that I was right—that it was more logical and profitable to start with the simplest matters and to finish with the more complex considerations. To begin with the diagram and the phase rule is discouraging to the student unless he be a highly trained man, well drilled in scientific methods. In following the other course, on the contrary, it is an easy task to interest the student at the very start, to keep him interested and to lead him by gentle steps to the consideration of those subjects which at the start would have proved very unattractive to him.

In regard to the determination of carbon by microscopical examination, I still think, notwithstanding your reviewer's remarks, that, when applied intelligently and confined to annealed hypœutectoid steels it is as accurate as the colorimetric method. Of course, it presupposes that the steel is homogeneous but so does the chemical analysis. It is not my experience that the results "only hold for the surface examined because the steel one-eighth of an inch below its surface may be and often is of different carbon content."

The separate paging of the lessons was adopted with a view of facilitating the preparation of subsequent revised editions as it makes it possible to remove bodily from the book any lesson, to rewrite it and to replace it without disturbing the balance of the work. It seemed to me that such a very great advantage outweighs so much the slight disadvantages of this departure from the usual custom as to justify the course adopted. Yours very truly,

ALBERT SAUVEUR,
Harvard University, Cambridge, Mass.

November 5, 1912.

Sir,—In reply to Professor Sauveur's letter, I would point out that Professor Sauveur admits himself that the great majority of teachers of metallography have found it advisable to deal with the Equilibrium Diagram of iron and steel before attempting to explain the structure of individual samples of iron or steel. Quite true,—the student's interest may be stimulated at the start by taking up a few examples of iron and steel by themselves; but, to take up the whole subject, as Professor Sauveur has done in his book, before reaching the equilibrium diagram, means that the student is likely to become confused; whereas, if the underlying principles covering all irons and steels are taught him first by considering the equilibrium diagram, he is then able to follow very easily the differences in structure of the various irons and steels. It would be logical, as Professor Sauveur says, to begin with the simplest matters and to finish with more complex considerations. In this case, however, one cannot truly understand even the simplest cases without a knowledge of the equilibrium diagram. The equilibrium diagram is the foundation. When this has been considered one is at liberty to begin at the simplest cases and proceed. The point is, that without first understanding the principles of the equilibrium diagram, the student is apt to think of each iron or steel sample as a separate case, whereas all the irons and steels constitute a series.

Without regard to the determining of carbon by microscopic means, it cannot be denied that metallographic examination is purely a surface test, and one can never hope to replace chemical methods, which depend upon samples being taken by means of a drill from various portions of the specimen, by metallographic observation. Yours very truly,

THOS. R. LOUDON,
Metallurgical Engineer, Toronto.

BOOK REVIEWS.

Reviewed by T. R. Loudon.*

Analysis of Metallurgical and Engineering Materials.—A Systematic Arrangement of Laboratory Methods. By Henry Wysor, B.S., assistant professor of analytical chemistry and metallurgy in Lafayette College. The Chemical Publishing Co., London: Williams & Norgate (14 Henrietta Street, Covent Garden, W.C.). Cloth; 8½ x 10½ in.; pp. 82. Price, $2, net.

The object of this manual is to present the work of the chemical analysis of metallurgical materials in an up-to-date logical order, both for the use of the college student and the practical chemist The departments outlined are given at the end of this review. It is sufficient to say that the book covers the metallurgical field very thoroughly.

The scheme of first stating the reagents required in a given piece of analysis and then outlining the determination is one that will make the work simple. Too often, the student has to read a great deal of matter not related directly to the subject before getting a definite statement of the reagents required.

The chapter devoted to the heat treatment of metals might be made a little more elaborate. It is a good step to include this department in the book, but, too little information is often worse than useless where heat treatment is concerned.

The book is an excellent up-to-date arrangement of the subject.

The following is a list of the chapters: Introduction; Sampling Ores by Hand; Specific Gravity of Solids; Analysis of Limestone; Analysis of Portland Cement; Analysis of Coal and Coke; Analysis of Iron Ore; Analysis of Chrome-Iron Ore; Analysis of Manganese Ore; Analysis of Copper Ore and Matte; Analysis of Lead Ore and Furnace Product:

* Metallurgical Engineer, Toronto.

Analysis of Zinc Ore; Analysis of Iron and Steel Works Cinders; Analysis of Iron; Analysis of Alloy Steel; Analysis of Ferro-Manganese and Iron Rich in Manganese; Analysis of Brass and Bronze; Analysis of Soft Bearing Metal; Analysis of Water; Analysis of Producer Gas; Calorimetry of Coal Coke and Oil; Calorimetry of Gases; Examination of Lubricating Oil; Examination of the Microstructure of Iron and Steel; Heat Treatment of Metals; Atomic Weights; Gravimetric Factors; Bibliography.

Reviewed by C. H. C. Wright.*

Elements of Drawing. By George F. Blessing, M.E., Ph.D., and Lewis A. Darling, E. in M.E. Published by John Wiley and Sons, New York. Canadian agents, Renouf Publishing Co., 25 McGill College Avenue, Montreal. 193 pages; 6 x 9 in.; fully illustrated.

While this book contains much useful information and a great many suggestions valuable to the instructor, it is so carelessly written and edited that it is a very unsafe text to put into the hands of the novice, for whom it is evidently written.

In chapter I. on the selection, care and use of drawing instruments, Fig. 31 illustrates the type of scale recommended for architectural or mechanical engineering work, and is an open divided triangular scale. The use of this scale is illustrated in Fig. 32, but unfortunately the diagram shows a scale continuously subdivided. The text on page 31 says: "To mark off a number of consecutive measurements, such as 2 in., 5 in., 1 in. and ½ in., along any straight line, keep the scale stationary and, beginning at zero, mark off in succession the distances 2 in., 2 in. + 5 in. = 7 in., 2 in. + 5 in. + 1 in. = 8 in. and 2 in. + 5 in. + 1 in. + ½ in. = 8½ in."

It is evident to the experienced what the authors wish to avoid, but what will the beginner do when the sum exceeds 12 inches?

The introductory remarks to Chapter II. are good, e.g., "Good lettering and dimensioning on working drawings is of prime importance and cannot be too strongly urged. The outline and characteristics of each letter and numeral must be carefully studied." One is shocked, however, by the statement on the opposite page that "The bar in both the E and F is exactly midway between the top and bottom of the letter," as well as by the many illustrations throughout this chapter showing the same gross blunder in these and other letters, such as B and S. That the authors know better than this is evident from many of the drawings illustrated throughout the book, e.g., pages 43 to 70.

The authors' limitation of the term "mechanical drawings" to those orthographic projections of an object when the principal lines are parallel to the planes of projection is odd, but their extended definition is very confusing to the beginner.

Chapter V., page 157, "Isometric drawing is based on the principles of isometric projection, but it is beyond the scope of this text to take up the discussion of the principles underlying this art. For the purposes of this work it will be necessary to state only two new principles not included in orthographic projection."

A simple statement may be all that is desirable in an elementary text book, but there can be no excuse for misleading the beginner into thinking that an isometric is not an orthographic projection. Again, principle (1) defining the solid angle and its position relative to the plane of projection is, to say the least, incomplete as a projection consisting of any three straight lines radiating from a point such as to make angles of 120 deg. with each other would satisfy the conditions as stated.

This chapter is poorly arranged for in the introductory article (116) the beginner reads about the uses, advantages and disadvantages of isometric projection before he is given the principles of the projection (art. 117) or an elementary example of it (art. 118).

Strength of Materials. By Mansfield Merriman. Published by John Wiley & Sons, Ltd., New York; Canadian agents, Renouf Publishing Co., 25 McGill College Ave., Montreal. Sixth edition, revised and reset. Cloth; 5 x 7½ in.; 169 pages; price $1.00.

This volume, which is a text book for secondary technical schools on the strength of materials, beams, columns and shafts, was first published in 1897. The book has been so well received in the past that it has now reached its sixth edition. In the fifth edition a new chapter was added on reinforced concrete, especially columns and beams. In this edition a new chapter on combined stresses is added. Numerous changes have been made throughout the book and many new problems introduced.

The book is too well known to need much comment, with the exception of noting the changes in this edition.

Steel Sheet Piling Tables and Data on the Properties and Uses of Sections. Carnegie Steel Company, Pittsburg, Pa. 5 x 7½ ins.; pp. 88; illustrated; paper.

This little book, which may be had from the United States Steel Products Co., 220 King Street West, Toronto, contains a large amount of valuable information, not readily available elsewhere, on the subject of steel sheet piling. While the data concern particularly the three types of steel piling manufactured by the Carnegie Steel Company, what is said applies to a large extent to all forms of steel piling. Some of the subjects treated are the strength of the three forms of piling mentioned under lateral, vertical and longitudinal forces; methods and cost of driving; special driving appliances; pulling; watertightness; uses to which steel piling may be put; general engineering tables bearing on the subject of earth pressures and piling.

The publication should be in the hands of all engineers and others interested in sheet piling.

The Cooking of Coal at Low Temperature, with a Preliminary Study of the By-products. By S. W. Parr and H. L. Olin, has just been issued as Bulletin No. 60 of the Engineering Experimental Station of the University of Illinois.

This bulletin gives the details of experiments in the carbonization of coal at relatively low temperatures, not exceeding 750 deg. Fahr. The studies indicate that the bituminous matter in Illinois coals is in excess of the amount necessary to produce bonding material for the non-coking or cellulose residuum of the coal and that the best cokes are produced when mixtures of fresh coal and non-coking coal materials, such as coke breeze or powdered anthracite, are used. The tests show that the by-products consist of a gas of high illuminating power and heat value (1030 B.t.u.), and tarry material which consist in the main of oils of low viscosity having marked oxygen-absorbing properties.

In a very important aspect, this work constitutes a study in smoke prevention from a chemical rather than a mechanical standpoint, and the results show that bituminous coal in a form for combustion without smoke is at least a theoretical possibility. An interesting feature of the work is the information it affords as to the theory of the coking of coal. The summary touching this point concludes, that "for the formation of coke there must be present certain bodies which have a rather definite melting point" and fur-

* Professor of Architecture, University of Toronto.

ther that "the temperature at which decomposition and carbonization take place must be above the melting point."

Copies of Bulletin No. 60 may be obtained upon application to W. F. M. Goss, director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

The Modern Gasoline Automobile, Its Construction, Operation, Maintenance and Repair. By Victor M. Pagé. Published by The Norman W. Henley Publishing Co., 632 Nassau Street, New York. pp. 693; 380 illustrations. Price, $2.50.

The faults in this book (a review is always supposed to find such) are noticeable by their scarcity.

The book is stated to be a "thoroughly practical, non-technical treatise," and is true to that description. Evidently the author is conversant with his subject, and while the work is very comprehensive in regard to the great amount of detail it contains, it is well written and the illustrations, being in many cases reduced from actual scale drawings, are clear and suitably chosen.

By a trained engineer much of the text could be dispensed with, but as this book is intended for owners of automobiles, chauffeurs and others, who may have no engineering knowledge, it is well suited to their needs, and should prove very useful to any reader of this class who may desire to understand his car, and particularly its engine, better.

The "Mechanical World" Pocket Diary and Year Book for 1913. Published by Emmatt & Co., Limited, "Mechanical World" offices, Manchester, England. Price, 6d. net.

This handy little book, now in its 26th year, contains a great deal of useful information on mechanical subjects. It is particularly suited to the needs of draughtsmen and is good value in spite of its low cost.

An electrical pocket book is also issued by the same firm, the style and price being identical with the one here referred to.

Differential and Integral Calculus. An introductory course for colleges and engineering schools. By Lorrain S. Hurlburt, Collegiate Professor of Mathematics in the Johns Hopkins University. New York and London: Longmans, Green & Co. Cloth; 5½ x 8½ in.; pp. 481; illustrated. Price, $2.25, net.

This book is intended as an elementary text book of the calculus. The author, for many years, has taught the subject without a text book, using lecture notes of his own placed in the hands of the students. These notes have been re-written from time to time and are now published in book form.

The book is most clearly written and a very logical presentation of the theory of the differential and integral calculus is given. The illustrations are exceedingly clear, and aid very much in an understanding of the text. The treatise is in every way to be commended to the student and engineer as a text book on the calculus.

Some Facts About Treating Railroad Ties. By W. F. Goltra, president of the W. F. Goltra Tie Company, Cleveland, Ohio. Paper; 6 x 9 in.; 105 pages; 8 folding plates. Price, $1.00.

This little volume is mainly a compilation of papers read before technical societies and articles published in the technical press, with the consequent discussion. The book also includes a discussion of the claims of the empty-cell process of treatment of creosote in which a proportion of the oil injected is withdrawn from the water. The following points are brought out in the author's discussion: The tie should be seasoned before treatment; that they should be treated to total refusal; that zinc chloride alone, and in combination with creosote, is more economical than creosote alone in treating ties to refusal; and that it is useless and impossible to group ties for treatment according to their species, degree of seasoning, proportions of heart, sapwood, etc. A letter along the same line will be found in this week's issue under "Letters to the Editor," written by Mr. Goltra.

The Properties and Design of Reinforced Concrete. Translated and abridged by Nathaniel Martin, C.E., and lecturer on "Reinforced Concrete," Royal Technical College, Glasgow. Published by Constable & Co., Limited, London. Cloth; 6½ x 9 in.; 116 pages; 28 tables; 29 figures. Price, $2.10.

The full title of this volume is "The Properties and Design of Reinforced Concrete, Instructions, Authorized Methods of Calculation, Experimental Results and Reports by the French Government Commissions on Reinforced Concrete."

As is well known, reinforced concrete had its origin in France. In December, 1900, a commission was appointed by the French Minister of Public Works, which embraced a group of engineers whose experience in this material was very wide. The work of this commission extending over the succeeding six years, included a series of experiments directed to the obtaining of results immediately applicable to practice. The report of the commission contains the results of the tests on experimental structures, and of the tests to destruction of several of the structures of the Paris Exhibition of 1900. The report has been much quoted and extracts have appeared from time to time in various English books and periodicals. In this volume the translator offers an abridged English edition which will afford professional men the opportunity to acquaint themselves with the scope of the work of the commission and to have the results at hand in readily accessible form.

The Official Good Roads Year Book of the United States. Edited by J. E. Pennybacker. Published by the American Highway Association, Colorado Building, Washington, D.C. Cloth; 6 x 9 in.; 406 pages. Price, $1.00.

This volume contains a concise digest of the road laws of all the States, a list of road contractors in the United States, a biblography of books, pamphlets, etc., pertaining to road building and maintenance, a list of colleges teaching highway engineering, and the course of instruction, a list of organizations working for road improvements, a directory of highway officials in the United States, a list of manufacturers of road machinery and materials, and a list of patents issued in 1911 in the United States relating to roads.

The book opens with a history of road-building, then, after a digest of the road laws in the different States, an analysis is given of the new suggested State Aid Bill. Chapters are then devoted to types of roads, road maintenance and repair, dust preventatives, highway bridges and culverts, bond issues, appropriation and mileage, and a section is devoted to the use of convict labor on roads.

Altogether, this book forms one of the most valuable additions to road-building literature which has come to our hand. The price, $1.00, in no way represents the value of the material contained in the volume.

Light: Its Use and Misuse, a primer on light and illumination which was published last month by the Illuminating Engineering Society, 29 West 39th Street, New York, has already gone into a second edition. Written in a clear and comprehensive manner for popular reading, this little pamphlet has met with immediate favor. It has occasioned considerable complimentary criticism from people who are generally supposed to have little or no interest in the subject of lighting. From the heads of engineering and physics departments of schools and colleges the society has received numerous letters of commendation, together with requests for quantities of the primer for distribution to students. Architects, engineers, oculists, merchants, and others have also expressed their appreciation of the publication. Several lighting companies are planning to issue it to their customers. One large manufacturing company in London has cabled for permission to print and distribute a large edition in Europe. It is not unlikely that the primer will go into many editions.

Engineering for Land Drainage. A manual for the reclamation of lands injured by water. By Charles Gleason Elliott, C.E., M. Am. Soc. C.E., author of "Practical Farm Drainage." Second edition, re-written. New York: John Wiley & Sons. Canadian agents, Renouf Publishing Co., 25 McGill College Avenue, Montreal. Cloth; 5 x 7½ in.; pp. 339; 60 text illustrations; 15 tables. Price, $2, net.

The first edition of this book appeared in 1902, when the question of land drainage was in a very elementary state. Since that time the development and extension of land drainage work has been continuous and substantial. A great deal of actual experimental data is now to hand and the author has therefore entirely re-written the original volume, so that this book is practically a new one.

The author has undoubtedly, in his former position of chief of drainage investigation, U.S. Department of Agriculture, had the opportunity of a better training in land drainage work than is usual. This book, which is partly the result of that experience, is without question the best treatise on drainage engineering to be found to-day. The only criticism which appears justified, in a casual analysis of the book, is that the author has not abandoned the old formulae for flow in pipes and ditches, which have been, to a great extent, abandoned by engineers. The use of these formulae gives results for flow greatly in excess of actual gaugings.

Drainage assessments are discussed in Chapter XVI. very clearly and concisely. Brief chapters are included on Levee Drainage Systems, Reclamation of Tidal Land, Drainage of Irrigated Lands, Drainage of Peat and Muck Lands, and Control of Hill Waters.

This volume, while perhaps too small to be considered a thorough treatise on the question of land drainage, will be found to be a most valuable one to the engineer interested in this work.

Modern Sanitary Engineering.—Part I., House Drainage. By Gilbert Thomson. Published by Constable & Co., Limited, London. Cloth; size, 5¾ x 8½ in.; 260 pages, 110 illustrations. Price, $1.60.

Of the numerous books on the above subject most have been written from the tradesman's point of view. At the same time many engineering problems are involved in the collection, conveyance and disposal of sewage. This volume deals specially with house drainage. Very few books are to be found which are based on general principles, and which lead from these to practical applications. This present treatise is based on a course of lectures on Sanitary Engineering delivered by the author in the Civil Engineering Department of the Royal Technical College, Glasgow. The book will be found to be a most invaluable one for the engineer interested in the sanitation of individual houses.

PUBLICATIONS RECEIVED.

Bridges Over Navigable Rivers.—Some practical considerations, by C. E. Smith. Being Vol. 14, No. 150, Bulletin of the American Railway Engineering Association. E. H. Fritch, secretary, 900 South Michigan Avenue, Chicago.

Institution of Civil Engineers of Ireland.—Being the transactions of the 76th section, November, 1911, to May, 1912. P. F. Purcell, honorary secretary, Dublin.

Map of City of Calgary.—Harrison & Ponton, engineers and surveyors, Calgary, Alta., forward copy of their latest revised map of the city of Calgary. Copies may be secured by addressing their office, Calgary.

Winnipeg Hydro-Electric Power Station.—Being a description of the Winnipeg hydro-electric power station, reprinted from "Engineering," July 26-Aug. 2, 1912. Vickers, Limited, of Sheffield, England, Canadian office, 20 Bleury Street, Montreal, will forward copies on request.

Text Books and Industrial Works.—The Canadian Engineer (Book Department), 62 Church Street, Toronto, have issued a new catalogue of text books and industrial works. Copies may be secured by addressing the Book Department, Canadian Engineer.

Rail Steel Concrete Reinforcement Bars.—Standard specifications for the above. Copies may be secured from the secretary of the American Steel Manufacturers' Association, address J. J. Shuman, c/o Jones & Laughlin Steel Company, Pittsburg, Pa.

Tide Tables for the Pacific Coast of Canada, for the year 1913. Issued by the Tidal and Current Survey, Department of the Naval Service, Dominion of Canada. Mailed free on request.

Tide Tables for the Eastern Coast of Canada, for the year 1913. Issued by the Tidal and Current Survey, Department of the Naval Service, Dominion of Canada. Mailed free on request.

Summary Report of the Mines Branch, Department of Mines, for the calendar year ending December 31st, 1912. Copies may be secured from Eugene Haanel, Director, Mines Branch, Department of Mines, Ottawa.

Weights and Measures, Gas and Electricity. Being Part 2 of reports, returns and statistics of the inland revenues of the Dominion of Canada for the year ending March 31st, 1912. Deputy Minister of Inland Revenue, Ottawa.

Sea Fisheries of Eastern Canada. Being the proceedings of a meeting of the Committee on Fisheries, Game and Fur-Bearing Animals of the Commission of Conservation, held at Ottawa, June 4th and 5th, 1912. Copies may be secured from the secretary, Commission of Conservation, Ottawa.

Report of the State Commission of Highways. Being the annual report of the State of New York for 1911. C. Gordon Reel, Superintendent of Highways, Albany, N.Y.

Supplement to the Annual Report of the State Engineer and Surveyor of the State of New York, for the fiscal year ending September 30, 1911. Being a report of the Bureau of Hydraulics, Department of the Barge Canal, comprising the 12th annual report on Steam Gauging. John P. Newton, assistant engineer, Albany.

Annual Report of the City Engineer of Toronto, for 1911. R. C. Harris, Commissioner of Works and City Engineer, Toronto, Ont.

Mine Fires. A preliminary study. By Geo. S. Rice. Being Technical Paper No. 24. Joseph A. Holmes, director, Bureau of Mines, Department of the Interior, Washington, D.C.

Mechanical Properties of Red Wood. By A. L. Heim. Being Circular 193, Forest Products Laboratory Series.

Henry S. Graves, Forester, Forest Service, U.S. Department of Agriculture, Washington, D.C.

A Study of Iowa Population. As related to industrial conditions. By John E. Brindley. Being Bulletin No. 27, Engineering Experiment Station, Iowa State College of Agriculture, Ames, Iowa.

Road Legislation and Administration in Iowa. By John E. Brindley. Being Bulletin No. 28, Engineering Experiment Station, Iowa State College of Agriculture, Ames, Iowa.

Some Fallacies and Facts Concerning Engineering Work in Great Britain. By W. A. Martin, late assistant general manager of the Toronto Electric Co. Being a reprint from The Canadian Engineer issues, August 8th and 15th, 1912. Copies may be secured from the Canadian British Engineering Co., Limited, Toronto.

CATALOGUES RECEIVED.

Rubber Insulated Wire and Cable.—The Standard Under-Ground Cable Co., of Canada, Limited, Hamilton, Ont., forward copy of their pamphlet entitled "Sterling Rubber Insulated Wire and Cable." This is an artistic little publication, describing the manufacture of the Standard Under-Ground Rubber Insulated Wire and Cable.

Fire-Proof Houses.—The National Fire-Proofing Company, Fulton Building, Pittsburg, forward the sixth edition of their "Fire-Proof Houses of Natco Hollow Tile and How to Build Them." The book is distributed gratis to architects, but a charge of twenty cents is made to the general public.

Electrically Welded Wire.—The Clinton Wire Cloth Co., of Massachusetts, forward copy of catalogue describing their "Clinton" electrically welded wire fabric for reinforcing concrete construction. The catalogue is a most artistic one and gives many illustrations of the use of Clinton wire.

Beatty Hoists.—Messrs. M. Beatty & Sons, of Welland, Ont., forward their last catalogue describing their steam and electric hoists. The bulletin shows illustrations of their hoisting engines, centrifugal pumps, derricks, dredges, scows and clam shell buckets.

Briquetting Machinery.—The United States Engineering Company, 80 Wall Street, New York City, forward brochure on briquetting machinery, illustrating and describing briquetting machinery for coal, coke and ore products, as manufactured by William Johnston & Sons, Limited, of Leeds, England, for whom they are the representatives.

Water Filtration.—The Loomis-Manning Distributing Company, 828 Land Title Building, Philadelphia, forward their catalogue describing the Loomis system of filtration, pressure or gravity. They also enclose a reprint of the December issue of Dun's Review, in which in every building mentioned in an article on "The Rebuilding of New York," the Loomis filter plant had been specified by the architects and engineers.

Metal Windows.—Henry Hope & Sons, Limited, 45 King Street West, Toronto, Ont., forward copy of Hope's Catalogue of Metal Windows. This is a magnificently bound and illustrated volume, 10 x 15 inches in size and containing about 200 pages. Typographically, the book is above criticism, and is in every way a most artistic publication.

Taylor Stokers.—The American Engineering Company, of Philadelphia, forward a pamphlet entitled "Facts Concerning the Operation of Taylor Stokers Obtained from the Users." The results of a number of tests are given in which the Taylor stoker was tried out. There are a number of interesting charts, and the tests themselves are of considerable interest.

Hayward Buckets.—The Hayward Company, 50 Church Street, New York, forward copy of their pamphlet No. 596, entitled "Hayward Buckets and Digging Machinery."

Transits and Levels.—Izard-Warren Company, 136 No. 12th Street, Philadelphia, Pa., forward catalogue describing their "Sterling" transits and levels.

Grout Mixers.—The Ransom Concrete Machinery Company, Dunellen, N.J., forward pamphlet entitled "The Use of Ransom-Canniff Grout Mixers."

Machinery and Supplies.—The Chicago Builders' Specialty Co., Room 450, Old Colony Building, Chicago, Ill., U.S., forward their catalogue No. 35, illustrating their machinery and general contractors' supplies.

Electrical Apparatus.—Ferranti, Limited, Hollinwood, Lancashire, England, through their Canadian representative, G. C. Royce, 1688 Dundas Strees, West Toronto, forward their latest revised catalogue illustrating their switchboard instruments, switch gear and accessories, transformers, etc.

HOLLINGER FINANCIAL STATEMENT.

The provisional statement of the company's finances, as on October 26th, 1912, is as follows:—

Assets and Liabilities.

Current Assets—			
Cash on hand and in Imperial Bank			$ 33,496.44
Bullion on hand			27,570.00
Bullion shipped (not paid for)			89,498.65
Gold precipitates on hand			97,500.00
Gold in mill solutions			24,000.00
Gold in slags on hand			17,000.00
Materials and supplies on hand			30,659.54
Accounts receivable			7,407.30
Guarantee Deposits			500.00
Imperial Bank, Toronto, reserve for dividend No. 1			90,000.00
Insurance paid in advance			2,832.41
			$ 420,464.34
Capital Assets—			
Mining properties		$2,500,000.00	
Developments		302,556.24	
Plant		593,728.09	
			$3,396,284.33
			$3,816,748.67
Current Liabilities—			
Wages			$ 18,254.00
Salaries			2,750.00
Accounts payable			36,972.86
			$ 57,976.86
Capital Liabilities—			
Capital stock			$3,000,000.00
Surplus, made up as follows, viz.:			
Premium on shares sold invested in plant and development		$250,000.00	
Profits from operations			
Reinvested in plant	$ 82,432.92		
Reserve for Dividend No. 1	90,000.00		
Balance in reserve	336,338.89	508,771.81	
			758,771.81
			$3,816,748.67

The above figures are provisional, and are subject to correction after actual returns from smelters are received. It is estimated that the surplus on November 2nd will amount to approximately $800,000.00

COAST TO COAST.

Halifax, N.S.—The management of the Provincial Exhibition has not, so far, proved a financial success. The deficit for the past season amounts to $10,500—about $400 less than last year.

Port Arthur, Ont.—There are now on the streets of the city about two thousand lights and this number will be considerably augmented next year as the lighting system is extended to the outlying sections.

Calgary, Alta.—The weather has been most favorable for contracting work during the past few weeks and several builders are taking advantage of the same and rushing through their several contracts.

Regina, Sask.—The demand on the power house for the past six years and the estimated demand for 1913 are given as follows: 1907, 833,039 kw.; 1908, 986,237 kw.; 1909, 1,201,160 kw.; 1910, 1,567,631 kw.; 1911, 2,458,535 kw.; 1912, 4,179,948 kw.; 1913, 7,000,000 kw.

Quebec, Que.—The Canadian Northern Railway Atlantic liner "Royal George," which was stranded on the rocks in the south channel off Point St. Lawrence, Island of Orleans, was released and floated into deep water at 4 o'clock Saturday afternoon, an hour before extreme high water.

Sydney, C.B., N.S.—The town of Sydney has witnessed an expenditure of about $600,000 in new buildings in the last ten months, and has also increased in population to an extent which makes the erection of more houses a necessity. This is another evidence of general progress in the lower provinces.

Calgary, Alta.—Grading has been started on the C.P.R. cut-off from Bassano to Swift Current at the Bassano end. Work is in progress as far as Empress, the new C.P.R. townsite, 120 miles east of Bassano. At the present time 30 miles of the road is in operation from the Swift Current end, and grading is being rapidly pushed to cover the 100 miles between that point and Empress.

Bassano, Alta.—It is reported that the C.P.R. intend making application for the approval of a route map of the Swift Current cut-off from Bassano to the forks of the Saskatchewan, 118 miles east. The new line practically parallels the Red Deer River and it is probable that Bassano will be made the divisional point. The new line leaves the main line 2½ miles east of Bassano and goes in a slightly northeasterly direction as far as the forks of the Saskatchewan.

Montreal, Que.—The newspapers of this city are giving considerable publicity to a scheme calling for the erection of an immense cathedral. A sum of about $2,000,000 has been offered for two churches now standing in the business section, and there is talk of this money being accepted and applied to the erection of the larger building. St. George's Church and Christ Church Cathedral (Anglican) are the buildings mentioned in this connection.

Calgary, Alta.—The total work completed on the various civic utilities for the year makes a considerable amount. According to the statement prepared by the engineering department and submitted to the commissioners the following are the totals for the year: Sewers, 277,375 feet; waterworks, 208,737 feet; sewer manholes, 627; water connections, 2,552; sewer connections, 2,604; sidewalks, 1,238,660 square feet; curb and gutter, 148,049 lineal feet; conduits, 337.

Ottawa, Ont.—Through the Minister of Justice, Hon. C. J. Doherty, the Canadian Government has filed objections before the International Joint Commission, now in session at Washington, to the proposed construction of an international dam at Kettle Falls, the outlet of Rainy Lake, on the Minnesota-Manitoba boundary. The government protested that the dam would affect the levels of the Lake of the Woods, which are now a matter of arbitration between the two governments.

London, Ont.—Mackenzie & Mann, it is announced, have asked that two proposals concerning the London and Port Stanley Railway be presented to the City Council immediately. Mayor Graham has arranged for a conference between C.N.R. representatives and members of the London and Port Stanley board, to be held next week. The proposition is creating much interest, especially in view of the fact that Hon. Adam Beck has just brought forward his scheme for the electrification of the road for municipal operation at a cost of $890,000. This latter scheme is to be voted on by the ratepayers of the city.

Montreal, Que.—The new building by-law, which has been in process of preparation for some time past by a committee of experts, of whom Messrs. J. Venne and W. J. Francis are members, has been submitted to the chairman of the special committee. It will be submitted to the city council, whence it will be sent to the Quebec Legislature for sanction. It is stated that the most sweeping recommendations include provision for preventing the spread of fire in factories, the introduction of smoke-proof towers for factories and schools, and the installation of efficient fire escapes. The report as submitted covers 213 closely typewritten pages, comprising 1,000 clauses. We hope in the very near future to submit an abstract of the by-law in these columns.

Niagara Falls, Ont.—The Queen Victoria Park Commissioners discussed the decision of the Privy Council recently confirming their right to collect rentals for excess power on the peak load system of measuring the electric current. It is now likely that the commissioners will at once exercise the power vested in them by the decision of the Privy Council, before which body this case has been pending for the past three years. Although the commissioners are disposed to favor the application of the Ontario Power Company for permission to install unit No. 13, the matter was left over for a conference between members of the power company and the park commissioners, to take place at Toronto in the near future. The plans submitted by the Electrical Development Company for a proposed machine shop were not acted upon, but the plans for a stairway leading to the transformer house at the summit of the hill were approved.

Province of Ontario.—A sanitary investigation of international waters from the St. Lawrence to the head of Lake Superior is to be carried on during the next year by the joint action between the Canadian and United States health authorities. The decision to extend the examination of boundary waters for evidence of pollution is the result of the suggestion made by the International Joint Commission at Washington last week. The waters to be examined include the Rainy River, St. Mary's River, River and Lake St. Clair, Detroit River, Niagara River, the St. Lawrence, Lake Superior in the neighborhood of Fort William, Port Arthur and Duluth, Lake Huron in the neighborhood of Saginaw Bay, Sarnia and Port Huron, the west end of Lake Erie around Port Stanley and Cleveland, and Lake Ontario near Toronto, the mouth of the Niagara River and around Rochester and Kingston. The Provincial Board of Health will have charge of the investigation of Ontario waters, and will do all the analytical work necessary.

Vancouver, B.C.—The report of the Northern Pacific for the year ended June 30th, 1912, shows that during the past three years terminal property at Vancouver has been bought in the interest of the Northern Pacific and the Great Northern, and is now being developed. When the plans now under consideration are completed there will be a first class terminal for both freight and passenger business owned jointly by the two companies. New station buildings were put up during the year and increased facilities provided at a number of places in Minnesota, in North Dakota, in Montana, in the State of Washington, and in Oregon. During the year 175 bridges were replaced and three abandoned, 111 bridges, 19,234 ft. in length, were replaced by timber structures, and seven permanent and 57 timber structures were replaced in permanent form. Of these, 46 were replaced by embankments and 18 were replaced by truss, girder, I-beam and reinforced concrete trestle, a total of 20,717 lineal feet, 119 timber culverts were rebuilt, 15 in temporary and 104 in permanent form. There are now under construction on operated lines 1,145 lineal feet of steel girder and I-beam spans; 870 lineal feet of steel truss spans; 1,408 lineal feet of reinforced concrete trestle; one 425-ft. double-track steel draw span and one 191-ft. movable leaf bascule span; also one steel highway viaduct, 738 ft. long.

Edmonton, Alta.—City commissioners of Edmonton, Alta., have called for tenders on 400,000 square yards of a total of 511,533 square yards of street paving to be laid the coming year. The estimated cost is $1,734,786. Tenders will be opened on December 10, a day after the civic election. The plans call for 422,643 square yards of paving on the north side of the Saskatchewan River, and 88,893 square yards on the south side, formerly known as Strathcona. This does not include all the work to be done during 1913. It is simply the paving that has been petitioned for to date. The city is holding in reserve 111,533 square yards of paving for the municipal-owned plant to be built next year. The largest amount of work on one street is 47,531 square yards in Nelson Avenue, between First and Twentieth Streets. Others range from 4,189 to 28,531 square yards. Most of the forty-one streets affected will have more than 10,000 square yards of pavement. Four of the streets lead toward the country. Among these are the Fort Saskatchewan and St. Albert trails, Stoney Plain Road and Namayo Avenue. Namayo Avenue, formerly the southern portion of the trail to Athabasca Landing, will be paved as far north as the Grand Trunk Pacific tracks. Although provisions may later be made to pave First Street to Alberta Avenue, at the present time the plans show a pavement to Norwood Boulevard about a mile.

ONTARIO GOOD ROADS ASSOCIATION.

The executive of the above held a meeting in Toronto on Wednesday, November 20th last to discuss several important matters, among which was the proposal of a convention. It was resolved that an exhibition and convention should be held in the Machinery Hall of the Canadian National Exhibition, Toronto, February 26th-28th next. At this exhibition various road building and improving machinery will be demonstrated and different varieties and qualities of road sections will be on view. The first day will be devoted to the engineer, another day will be given to country roads and the other to town and city roads. Special facilities will be arranged whereby delegates will be able to attend the convention and hear the various speakers with comfort, it being decided to partition off a section of the building for this purpose. Major T. L. Kennedy, president of the association, and Vice-president N. Vermilyea were appointed to represent the association at the American Road Builders' Association, to be held December 3rd in Cincinnati. Mr. George Henry, Oriole, Ontario, is on a committee appointed to secure a permanent secretary.

The constitution of the association has been altered in order that all associations interested in improved roads may be represented at the February convention.

EFFECT OF METERS ON WATER CONSUMPTION.

The statistics given in the accompanying table are a concrete example of the effect of meters on consumption, and should commend itself forcibly to all citizens, in that it proves conclusively the fact that to meters more than to any other factor credit is due for checking wilful or neglectful waste of water. The figures are taken from the annual report of the Water Department of Houston, Texas. A pumpage of 141 gals. per capita in 1907 has been reduced to 53 gals. per capita to-day without depriving any person of this essential element. Dire results were predicted by fearful people just four years ago when the meter system was proposed, but to-day those who were formerly antagonistic are firm believers in this plan of delivering water to consumers.

Effect of Meters on Water Consumption, Houston, Texas.

Year.	Number of meters.	Percentage of consumers metered.	Average per capita pumpage.	Population city census.
1907	108	1.5 %	141 gals.	73,017
1908	303	4.0	122 gals.	79,464
1909	1,903	21.0	106 gals.	82,542
1910	4,556	48.0	82 gals.	95,930
1911	8,131	82.0	53 gals.	109,594

A total of 2,125,981,520 gals. of water was pumped as reported by the Chief Engineer for the year 1911, as compared to 2,859,091,610 gals. for the year previous. This represents a saving of 733,110,090 gals., notwithstanding several large conflagrations which occurred during 1911.

This fact deserves more than casual notice, as it is an economy that means more to the city than is represented in mere figures. It is a supply of pure water held in reserve for future use, insuring at the same time a lease upon the practical capacity of the wells for a greater period of time.

BRANCH MEETING.

At a joint conference held recently in the city of Victoria, B.C., between representatives of the Vancouver and Victoria branches of the Canadian Society of Civil Engineers, it was decided to hold a convention in Victoria in the early part of December at which subjects of interest to the profession will be discussed and plans prepared for a demand upon the government for legislation at the coming session of the legislature in order to protect the interests of the Canadian engineers. Chief among the demands to be made upon the government will be one asking that as far as possible positions in the government service shall be confined to British subjects.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.

Mr. Benjamin E. Briggs, city engineer of Erie, Pa., was elected president of the American Society of Municipal Improvements at the annual convention in Dallas, Texas, November 13th to 15th. Messrs. Edward H. Crist, of Grand Rapids, Mich.; William A. Howell, of Newark, N.J., and A. F. MacCallum, of Hamilton, Ont., were elected vice-presidents; Mr. A. Prescott Folwell, of New York city, was re-elected secretary, and Mr. E. L. Dalton, of Dallas, Texas, treasurer.

PERSONAL.

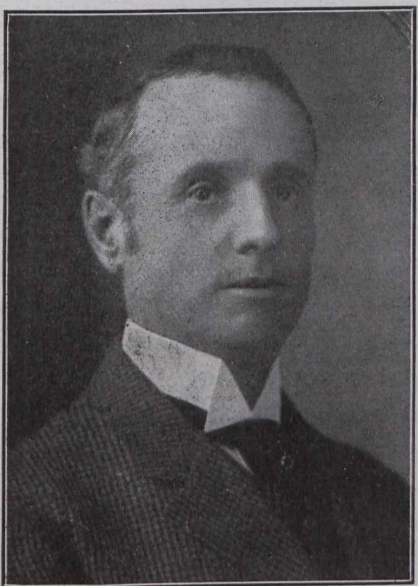
W. E. STAVERT, of Montreal, Quebec, has been elected president and general manager of the Alaska Northern, to succeed O. G. Laberee, resigned.

WM. HALL has been appointed assistant trainmaster of the Grand Trunk with office at Hamilton, Ont., succeeding L. Harold, assigned to other duties.

A. F. MACCALLUM, C.E., city engineer of Hamilton, Ont., has been elected a vice-president of the American Society of Municipal Improvements. The society had their annual meeting, November 13th to 15th, at Dallas, Texas.

MR. R. A. SARA, B.A.Sc., has resigned his position as assistant business manager of the Winnipeg power department and will return to his home in Toronto in order that he may become connected with the Hydro-Electric Commission in that city. He is a '09 graduate of Toronto University in electrical and Mechanical engineering.

DONALD M. McINTYRE, K.C., solicitor of the city of Kingston, who has recently been appointed chairman of the Ontario Railway and Municipal Board, is a native of Kingston and has lived there practically all his life. He is a graduate in Arts of Queen's University, and was called to the bar in 1885 with honors, obtaining the gold medal. He served as alderman in the city council from 1889 to 1905, except during 1892, when he was elected as mayor. In 1895 Mr. McIntyre was appointed city solicitor, in which office he has served to date. For many years he has been a trustee of Queen's University, a governor of the School of Mining, and is at present chairman of the Board of Governors of the School of Mining. He is a governor of the Kingston General Hospital, of which board he was chairman for the year 1904 to 1905. Mr. McIntyre is a member of the Frontenac Club and of the Kingston Golf and Country Club. He is a junior member of the law firm of McIntyre & McIntyre, practising in Kingston. As chairman of the Ontario Railway and Municipal Board he will be brought more intimately in touch with the engineering profession than in the past, and we therefore wish Mr. McIntyre every success in his new work.



Mr. Donald M. McIntyre, K.C.

MR. THV. HEYERDANL, chief engineer for the Canadian Office of Escher Wyss & Company, Zurich, Switzerland, is severing his connection with the company, and will leave Canada shortly. Mr. Th. Seidl, previously in charge of the engineering department of the London office of Escher Wyss & Company, has been appointed as Mr. Heyerdanl's successor.

R. F. PACK, general manager of the Minneapolis General Electric Company, formerly general manager of the Toronto Electric Light Company, has been appointed a member of the Smoke Prevention Committee of the Minneapolis Civic and Commerce Association.

DR. WILLIAM M. MACKAY, M.E., of the Reserve Mines, C.B., has been appointed Senator by the Canadian Government. Dr. MacKay has been interested in engineering contracting for many years.

NATHANIEL CURRY, of Amherst, N.S., has been appointed to the Senate by the government. Mr. Curry is president of the Canada Car and Foundry Company, Canadian Steel Foundries, Limited, and the Rhodes, Curry & Company, Limited. He is also a director in the Canadian Light and Power Company, Canada Cement Company and a number of other companies. He was born in Kings County, N.S., in 1851.

CHAS. L. DUNFORD, late of the city engineer's office, Toronto, was recently appointed assistant city engineer of London, Ont. After seven years' experience in England, Mr. Dunford came out to Canada and joined the firm of Ross & Holgate, consulting and supervising engineers, Montreal. After being with them for two years, he left to superintend the construction of a new and modern factory for the Standard Drain Pipe Company, of St. Johns, Que., and later some building work for the same firm in New Glasgow, Nova Scotia. He joined the main drainage works (Toronto), in November, 1908, and worked on the trunk sewer system, disposal works, Ashbridge's Bay improvement and grade separation schemes, and in 1910 visited England and reported to Mr. Chas. H. Rust (at that time city engineer) on several of the largest disposal works in England. Shortly after Mr. A. C. D. Blanchard's appointment as city engineer of Lethbridge, Mr. Dunford changed from the main drainage works to the sewer department, where he worked on the storm overflow sewer system, and was for some months resident engineer on the Carlaw Avenue storm overflow sewer. Later he worked with Mr. R. R. Knight on the combined sewer system for West Toronto, from which work he resigned to take up his new duties.

MR. J. S. MacLACHLAN, of Victoria, B.C., has been appointed resident engineer of federal public works on Vancouver Island. Mr. MacLachlan is a graduate of the Royal University, Dublin, and has been in Canada since the early part of 1911.

JOHN W. WATSON has been appointed as head of the accounting and purchasing department of the Works Department of Toronto by Commissioner R. C. Harris, and the appointment has been sanctioned by the city council.

OBITUARY.

MR. CHARLES W. LEONARD, of London, Ont., died at his home in that city recently. He was a member of the firm of E. Leonard and Sons, London, Ont., manufacturers of engine boilers and other heavy sheet iron products.

IMPERIAL DRY DOCK COMPANY.

The proposed steel plant and shipbuilding industry at East St. John is practically assured. Messrs. Norton Griffiths and Company have acquired the charter of the Imperial Dry Dock Company, and are negotiating with the city and the provincial and federal governments to guarantee the sinking funds on its bond issues, in establishing an immense plant beside the dry dock. They will also ask the federal government to agree to the enlargement of the dry dock to a length of 1,150 feet, which it is said would make it the largest in the world. It would be necessary to reclaim 200 acres near the dry dock to be the site of the steel plant and ship yards. The fullest confidence is expressed in St. John that this great industry will be established.

APPEAL FOR THE HOSPITAL FOR SICK CHILDREN.

Mr. J. Ross Robertson, chairman of the trustees of the Hospital for Sick Children, Toronto, has written to The Canadian Engineer, asking that the needs of this institution be brought to the attention of our readers.

In his letter he states: Last year we treated 1,294 in patients, and 341 of these came from 218 places in Ontario. I feel that no more worthy cause can be presented for generous public support.

Any reader wishing to contribute toward the upkeep of this worthy cause may send his contribution to Mr. Douglas Davidson, Secretary-Treasurer of the Hospital, Toronto.

COMING MEETINGS.

CANADIAN SOCIETY OF ENGINEERS.—Mechanical Section Meeting will be held in the rooms of the Society, 413 Dorchester Street West, Montreal, December 5th, 1912. Chairman, H. H. Vaughan.

NATIONAL ASSOCIATION OF CEMENT USERS.—December 12th to 18th. Annual Convention, Pittsburgh, Pa. President, R. L. Humphrey, Harrison Building, Philadelphia, Pa.

UNION OF MANITOBA MUNICIPALITIES.—Programme for Ninth Annual Convention to be held in Convention Hall of the Industrial Bureau, Winnipeg, Nov. 26, 27, 28, 1912. Secretary, Reeve Cardale, Oak River, Man.

AMERICAN WOOD PRESERVERS' ASSOCIATION.—Ninth Annual Convention will be held at Chicago. Jan. 21-23, 1913. Secy-Treasurer, F. J. Angier, Mount Royal Station, B. & O. R. R., Baltimore, Md.

AMERICAN INSTITUTE OF CONSULTING ENGINEERS.—Annual Meeting, January 14th, 1912, will be held at The Engineers Club, 32 West Fortieth Street, New York, N.Y. Secretary, Eugene W. Stern, 103 Park Avenue, New York.

THE INTERNATIONAL ROADS CONGRESS.—The Third International Roads Congress will be held in London, England, in June, 1913. Secretary, W. Rees Jeffreys, Queen Anne's Chambers, Broadway, Westminster, London, S.W.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Ninth Annual Convention will be held in Cincinnati, December 3, 4, 5 and 6, 1912. Secretary, E. L. Power, 150 Nassau St., New York.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—Twelfth Annual Meeting to be held in Canada during the summer of 1913. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, W. F. TYE; Secretary, Professor C. H. McLeod.

KINGSTON BRANCH—Chairman, A. K. Kirkpatrick; Secretary, L. W Gill; Headquarters: School of Mines, Kingston.

OTTAWA BRANCH—
177 Sparks St. Ottawa. Chairman, R. F. Uniacke, Ottawa; Secretary, H. Victor Brayley, N.T. Ry., Cory Bldg. Meetings at which papers are read, 1st and 3rd Wednesdays of fall and winter months; on other Wednesday nights in month there are informal or business meetings.

QUEBEC BRANCH—Chairman, W. D. Baillairge; Secretary, A. Amos; meetings held twice a month at room 40, City Hall.

TORONTO BRANCH—96 King Street West, Toronto. Chairman, T. C. Irving; Secretary, T. R. Loudon, University of Toronto. Meets last Thursday of the month at Engineers' Club.

VANCOUVER BRANCH—Chairman, C. E. Cartwright; Secretary, Mr. Hugh B. Fergusson, 911 Rogers Building, Vancouver, B.C. Headquarters: McGill University College, Vancouver.

VICTORIA BRANCH—Chairman, F. C. Gamble; Secretary, R. W. MacIntyre: Address P.O. Box 1290.

WINNIPEG BRANCH—Chairman, J. A. Hesketh; Secretary, E. E. Brydone-Jack; Meets every first and third Friday of each month, October to April, in University of Manitoba, Winnipeg.

MUNICIPAL ASSOCIATIONS

ONTARIO MUNICIPAL ASSOCIATION—President, Mayor Lees, Hamilton. Secretary-Treasurer, Mr. K W. McKay, County Clerk, St. Thomas, Ontario.

SASKATCHEWAN ASSOCIATION OF RURAL MUNICIPALITIES.—President, George Thompson, Indian Head, Sask.; Secy-Treasurer, E. Hingley, Radisson, Sask.

THE ALBERTA L. I. D. ASSOCIATION.—President, Wm. Mason, Bon Accord, Alta. Secy-Treasurer, James McNicol, Blackfalds, Alta.

THE UNION OF CANADIAN MUNICIPALTIES.—President, Chase. Hopewell, Mayor of Ottawa; Hon. Secretary-Treasurer, W. D. Lighthall, K.C. Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Councillor Siddall, Port Elgin; Hon. Secretary-Treasurer J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. S. MacMillan, Warden, Antigonish, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Bee, Lemberg; Secy-Treasurer, W. F. Heal, Moose Jaw.

UNION OF BRITISH COLUMBIA MUNICIPALITIES.—President, Mayor Planta, Nanaimo, B.C.; Hon. Secretary-Treasurer, Mr. H. Bose, Surrey Centre, B.C.

UNION OF ALBERTA MUNICIPALITIES.—President, F. P. Layton, Mayor of Camrose; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALITIES.—President, Reeve Forke, Pipestone, Man.; Secy-Treasurer, Reeve Cardale, Oak River, Man.

CANADIAN TECHNICAL SOCIETIES

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

BRITISH COLUMBIA SOCIETY OF ARCHITECTS.—President, Hoult Horton; Secretary, John Wilson, Victoria, B.C.

BUILDERS' CANADIAN NATIONAL ASSOCIATION.—President, E. T. Nesbitt; Secretary-Treasurer, J. H. Lauer, Montreal, Que.

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Wm. Norris, Chatham, Ont.; Secretary, W. A. Crockett, Mount Hamilton, Ont.

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Secretary-Treasurer, Wm. Snaith, 57 Adelaide Street, Toronto, Ont.

CANADIAN CLAY PRODUCTS' MANUFACTURERS' ASSOCIATION.—President, W. McCredie; Secretary-Treasurer, D. O. McKinnon, Toronto

CANADIAN ELECTRICAL ASSOCIATION.—President, A. A. Dion, Ottawa Secretary, T. S. Young, 220 King Street W., Toronto.

CANADIAN FORESTRY ASSOCIATION.—President, John Hendry, Vancouver. Secretary, James Lawler Canadian Building, Ottawa.

CANADIAN GAS ASSOCIATION.—President, Arthur Hewitt, General Manager Consumers' Gas Company, Toronto; John Kelilor, Secretary-Treasurer Hamilton, Ont.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President W. Doan, M.D., Harrietsville, Ont.; Secretary-Treasurer, Francis Dagger, 21 Richmond Street West, Toronto.

THE CANADIAN INSTITUTE.—198 College Street, Toronto. President J. B. Tyrrell; Secretary, Mr. J. Patterson.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President Dr. A. E. Barlow, Montreal; Secretary, H. Mortimer Lamb, Windsor Hotel Montreal.

CANADIAN PEAT SOCIETY.—President, J. McWilliam, M.D., London, Ont.; Secretary-Treasurer, Arthur J. Forward, B.A., 22 Castle Building, Ottawa, Ont.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—President, Dr. Charles A. Hodgetts, Ottawa; General Secretary, Major Lorne Drum, Ottawa.

CANADIAN RAILWAY CLUB.—President, A. A. Goodchild; Secretary James Powell, P.O. Box 7, St. Lambert, near Montreal, P.Q.

CANADIAN STREET RAILWAY ASSOCIATION.—President, Patrick Dubee, Montreal; Secretary, Acton Burrows, 70 Bond Street, Toronto.

CANADIAN SOCIETY OF FOREST ENGINEERS.—President, Dr. Fernow, Toronto.; Secretary, F. W. H. Jacombe, Department of the Interior, Ottawa.

CENTRAL RAILWAY AND ENGINEERING CLUB.—Toronto, President G. Baldwin; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July and August.

DOMINION LAND SURVEYORS.—President, Mr. R. A. Belanger, Ottawa Secretary-Treasurer, E. M. Dennis, Dept. of the Interior, Ottawa.

EDMONTON ENGINEERING SOCIETY.—President, J. Chalmers; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alberta.

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, J. E. Ritchie; Corresponding Secretary, C. C. Rous.

ENGINEERS' CLUB OF MONTREAL.—Secretary, C. M. Strange, 9 Beaver Hall Square, Montreal.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President Willis Chipman; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp Secretary, P. F. Rowell, Victoria Embankment, London, W.C.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

INSTITUTION OF MINING AND METALLURGY.—President, Edgar Taylor; Secretary, C. McDermid, London, England. Canadian members of Council:—Prof. F. D. Adams, J. B. Porter, H. E. T. Haultain and W. H. Miller and Messrs W. H. Trewartha-James and J. B. Tyrrell.

INTERNATIONAL ASSOCIATION FOR THE PREVENTION OF SMOKE.—Secretary R. C. Harris, City Hall, Toronto.

MANITOBA ASSOCIATION OF ARCHITECTS.—President, W. Fingland, Winnipeg; Secretary, R. G. Hanford.

MANITOBA LAND SURVEYORS.—President, George McPhillips; Secretary-Treasurer, C. G. Chataway, Winnipeg, Man.

NOVA SCOTIA MINING SOCIETY.—President, T. J. Brown, Sydney Mines, C. B.; Secretary, A. A. Hayward.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. N. MacKenzie; Secretary, A. R. McCleave, Assistant Road Commissioner's Office, Halifax, N.S

ONTARIO ASSOCIATION OF ARCHITECTS.—President, C. P. Meredith, Ottawa; Secretary, H. E. Moore, 195 Bloor St. E., Toronto.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, Major. T. L. Kennedy; Hon. Secretary-Treasurer, J. E. Farewell, Whitby; Secretary-Treasurer, G. S. Henry, Oriole.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, T. B. Speight, Toronto; Secretary, L. V. Rorke, Toronto.

TECHNICAL SOCIETY OF PETERBORO.—Bank of Commerce Building, Peterboro. General Secretary, N. C. Mills, P.O. Box 995, Peterboro, Ont.

THE PEAT ASSOCIATION OF CANADA.—Secretary, Wm. J. W. Booth, New Drawer, 2263, Main P.O., Montreal.

PROVINCE OF QUEBEC ASSOCIATION OF ARCHITECTS.—Secretary, J. E. Ganier, No. 5, Beaver Hall Square, Montreal.

REGINA ENGINEERING SOCIETY.—President, A. J. McPherson, Regina; Secretary, J. A. Gibson, 2429 Victoria Avenue, Regina.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, H. C. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chausse, No. 5, Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Louis B. Stewart, Toronto; Secretary, J. R. Collins, Toronto.

SOCIETY OF CHEMICAL INDUSTRY.—Wallace P. Cohoe, Chairman, Alfred Burton, Toronto, Secretary.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, W. G. Mitchell; Secretary, H. F. Cole.

WESTERN CANADA IRRIGATION ASSOCIATION.—President, Duncan Marshall, Edmonton, Alta. Permanent Secretary, Norman S. Rankin, P.O. Box 1317, Calgary, Alta.

WESTERN CANADA RAILWAY CLUB.—President, R. R. Nield; Secretary W H. Rosevear, P.O. Box 1707, Winnipeg, Man. Second Monday, except June, July and August at Winnipeg.