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The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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The Canadian Engineer

ESTABLISHED 1893.

Issued Weekly in the interests of the

CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

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TORONTO, CANADA, JULY 2, 1909.

CONTENTS OF THIS ISSUE.

VOLUME XVII.

With this issue we commence a new volume. In last week's issue appeared a complete index of the first twenty-six issues of this year. It will be found to cover the engineering problems that have to be faced in Canada and when bound with Volume XVI. will be a great aid in reference work.

The size of the journal has been so increased that semi-annual volumes are necessary. The support the journal is receiving from subscribers and advertisers is so generous that we can promise more interesting articles, fuller market reports, and a more complete news service than formerly.

FREIGHT TRAIN LOADS.

The record for hauling large freight trains was made by a Pennsylvania railroad last month, when it drew 4,451 tons of coal 124 miles in 7 hours and 15 minutes. The train consisted of an engine and tender, weighing 241,000 pounds; 85 steel gondola cars and a caboose, the total weight being 6,151 tons, and the length of train was 3,000 feet, or almost three-fifths of a mile.

Previous to this the company had made other tests over the same line. The results were as follows:—

No.	No. of cars.	Total weight of train, tons.	Time. Hrs.	Min.
1	75 steel	5,307	10	21
2	75 "	5,348	8	2
3	75 "	5,348	10	12
4	85 mixed	4,852	12	30
5	86 "	4,922	9	42
6	87 "	4,623	10	21

These runs were made over a section on which grades were reduced to 0.2 per cent. compensated for curvature.

The figures give some idea of the volume of freight a modern railway can handle, and bring the railway and canal in closer competition.

A NEW ROAD COVERING.

From Minnesota comes information of a new method of road-making. In certain sections of the State the highway soil was very sandy, and to make passable roads the highway engineer employed clover and sawdust.

Along the roadside and on the shoulders of the road clover and rye were sown. This grew and prevented the blowing of the sand. Then at intervals the clover and rye were cut and thrown on the travelled part of the road allowance. Sometimes sawdust was added, and as the material rotted and worked up with the sand the highway became firmer, and it could be graded like a loam road.

On another strip four inches of sawdust was spread, and this, too, made a good road.

THE CANADIAN SOCIETY OF CIVIL ENGINEERS.

The Canadian Society of Civil Engineers held their annual excursion on June 24th to Detroit. The journey was interesting. The works examined at Walkerville, Windsor and Detroit were very instructive.

It is a wonder more engineers do not avail themselves of the opportunity such trips afford of becoming acquainted with their fellow-engineers.

RAILWAY ACCIDENTS.

In this issue will be found a list of accidents that occurred on the steam and electric railways of Canada during June, 1909.

It is just possible that the list is not complete, but as we enlarge upon the work our list will become more accurate.

Our purpose in preparing this list is to have at hand the information that will enable us to classify accidents according to cause with the hope that with publicity will come education, and thus a lessening of accidents.

EDITORIAL NOTES.

"Principles Governing the Compression of Air and Some Notes on its Uses" is the title of a paper to be read before the Engineers' Club of Toronto on Monday evening, July 5th, at 8.15, by Mr. William Reavell, M. Inst. M.E., M. Inst. C.E., etc., of Ipswich, England. Mr. Reavell is recognized as an authority on air compressors, and his address will be of interest to all.

* * * *

The Dominion Steel Company's statement, issued June 16th, was very favorable, even though the year's earnings (which show a net surplus of $1,571,412) are less than last year's. The operations of the twelve-month, after paying all expenses except interest, and after providing for sinking fund, depreciation and renewal of plant, show a profit of $2,225,834. Profit and loss was credited in March last with $2,209,210, transferred from contingent account in connection with the claim against the Coal Company, and the Steel Company directors have appropriated $1,800,000 of this in reduction of property and construction account. The reports of the English engineers, Messrs. Harbord and Hall, on the company's supply of coal, ore and other materials at Bell Island, Wabana, Marble Mountain and Sydney are very commendatory.

For the eleven months ending May 31st, the net earnings of the Canadian Northern were $2,562,900, against $2,272,200 last year, and $1,785,100 in 1907.

RAILROAD ACCIDENTS

Summary of Casualties in Canada During June.

Thirty Killed—Many Injured—Neglect Cause of Many Fatalities.

June 1st.—At Myrtle, Ont., C.P.R. fireman William E. Reid was struck by a waterspout, whilst leaning out of the cab, and killed.

At Emery, Ont., James Duncan, of Emery, was cut to pieces by a C.P.R. passenger train. He attempted to cross in front of a C.P.R. express.

At Parry Sound, Ont., the flange of a C.P.R. freight car wheel broke and several cars left the rails. Train crew sustained slight injuries and traffic was delayed several hours.

At Smith's Falls, Ont., C.P.R. Engineer Bennett, of Havelock, was badly scalded. Cause, boiler of engine drawing Montreal express burst.

At Halifax, N.S., James B. Anderson, aged five years, killed by street car, whilst crossing tracks.

At London, Ont., Vincent Famulara, age 1½ years, run over by street car and seriously injured.

At Missanabie, Ont., C.P.R. Atlantic Express derailed. Cause, broken wheel; delay, five hours.

At Hobon, Ont., C.P.R. Imperial, Limited ran into open switch, instantly killing an unknown tramp who was stealing a ride, injuring the engineer, and damaging the engine and mail car. Delay, three hours.

At Quebec an I.C.R. brakeman named Anctil, of Fraserville, took a fit whilst walking on track and was killed by a passenger train.

June 2.—At Brockville, Ont., a G.T.R. manifest train was wrecked, causing much damage to track and rolling stock, and blocking both lines for seven hours.

At Point aux Trembles, Que., Joseph L. Benoit, a C.N.R. brakeman was killed whilst shunting cars. Missed footing in attempt to board engine and crushed by tender.

At Thornhill, Ont., a C.N.R. passenger train was derailed and delayed traffic several hours.

June 3.—At Galt, Harry Drinkwater, knitter, very deaf, wheeling across track, killed by G. P. & H. car.

June 4.—Near Ingersoll, G.T.R. flyer derailed; two injured; cause, washout in track.

At West Toronto, Ont., Duncan Reid, a miller, of Streetsville, Ont., tried to board moving C.P.R. train, fell beneath wheels and lost left arm.

June 5.—At Ottawa, Ont., Leslie Stanley, aged 7, run over and killed by street car.

June 7.—At Toronto, Ralph Jasper, 12, foot caught in switch, crushed by car which was being shunted.

At Montreal, a Syrian woman struck by street car sustained slight injuries.

June 9.—At Grandes Piles, Que., C.P.R. engineer killed in head-on collision between local pilgrimage train.

At North Sydney, N.S., 16 cars of coal left tracks and damaged badly; 200 feet of track torn up. Cause, spreading rails. None of train crew injured.

June 10.—At Vancouver, B.C., two G.N. express trains collided head-on, killing two engineers and a fireman and injuring three passengers and three train hands.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of June 21		STOCK QUOTATIONS TORONTO				MONTREAL			
				1909	1908	Price June 25 '08	Price June 17 '09	Price June 24 '09	Sales Week End'd Jun. 24	Price June 25 '08	Price June 17 09	Price June 24 '09	Sales Week End'd Jun 24
Canadian Pacific Railway	8,920.6	$150,000	$100	1,481,000	1,287,000	159	.....	181¾	56	160	159¾	181	182⅝ 182½ .....
Canadian Northern Railway	2,986.9	.....	.....	184,500	151,200	.....	.....	.....	.....	.....	.....	.....	....
*Grand Trunk Railway	3,536	226,000	100	826,865	818,672	.....	.....	*1st. pref. 106, 3rd pref. 56⅛, ordinary 23¾		.....	.....	.....	....
T. & N. O.	334	(Gov. Road)	.....	24,104	16,656	.....	.....	.....	.....	.....	.....	.....	....
Montreal Street Railway	138.3	18,000	100	86,575	74,764	.....	.....	.....	.....	178	177¾	218 217	218 217¾ 405
Toronto Street Railway	114	8,000	100	79,709	70,307	.....	.....	123¾	99	98¾	98	124⅝ 124½	124 123¾ 605
Winnipeg Electric	70	6,000	100	.....	.....	157	189	185	85	159	158	....	185 .....

* G.T.R. Stock is not listed on Canadian Exchanges These prices are quoted on the London Stock Exchange.

At West Lorne, Ont., Peter Welsh, a sectionman, struck by M.C.R. express and instantly killed. Stepped from other track out of road of freight train.

At Dalton, Ont., two C.P.R. work trains met in a head-on collision, killing a train hand and seriously injuring the trainmaster. Cause, mistaken signals.

At Newtonville, Ont., G.T.R. passenger engine and baggage car left rails. Nobody injured. Cause, broken rail.

June 11.—At Brampton, Ont., Joshua Moddison, badly injured by C.P.R. express whilst walking on track. He is quite deaf and did not hear train approaching.

June 12.—At Toronto, a street car trailer left rails and collided with a sprinkler on other track, injuring five, none seriously.

At Cobalt, a man was found on T. & N.O. tracks with both legs severed. He died later.

At St. Therese, Que., a young man named Paquette jumped from a C.P.R. train travelling 35 miles an hour, followed by his father. The son died some hours later; the father will probably live.

At St. Jerome, Que.—A two year old child crawled on the tracks and was killed by a C.P.R. passenger train.

Near Hamilton, on the Hamilton and Dundas electric line, a trolley car was derailed and several passengers sustained injuries.

Near Port Hope the G.T.R. express train from Toronto to Montreal left the rails. No passengers were seriously hurt. Four hundred yards of track were torn up. Probable cause, watersprings undermined track.

At Toronto, Mrs. Crawford was alighting from a street car and fell to the pavement, sustaining slight injuries. Mrs. McKenzie had a similar experience.

Near Whitby, several G.T.R. freight cars in a train of 50 left the rails.

June 17.—Near Viscount, Sask., a freight train was wrecked and several cars left the rails.

June 17.—At Ottawa, Ont., Paul Brennan, G.T.R. yard-master, was instantly killed. He fell off the footboard of a shunting engine under the wheels.

June 18.—At Russell, Man., C.N.R. engine No. 100 and construction train left the tracks, turned over on her side and pinned the engineer between the engine and tenders, badly injuring one of his legs. Cause, spreading of skeleton tracks.

At Winnipeg, Man., Mrs. Alex. MacDonald was run over by a street car trailer and injured.

June 19.—At Hamilton, Ont., a street car jumped the track, injuring two passengers.

June 20.—On the Chipman-Moncton, N.B., section of the G.T.P., a supply train ran away and jumped the track, killing two and injuring two more, whose recovery is doubtful.

June 21.—At London, Ont.—William Clark, a G.T.R. crossing watchman, struck by engine and badly shaken up.

June 22.—At Toronto, Patrick McGovern attempted to board a moving train. He fell under the wheels of a car and a portion of his left foot had to be amputated.

At New Westminster, B.C., a G.N. engine left tracks and plunged into the Fraser River. Engineer and fireman were drowned. Cause, open switch.

June 22.—At Winnipeg, Man., Thomas Young was struck by a street car and died a few hours later.

At Ottawa, a boy who was struck by a street car was compelled to have his leg amputated.

June 24.—At Haileybury, Ont., an express from Toronto ran into a siding through a misplaced switch. Damage to rolling stock only.

At Toronto, three women were injured whilst alighting from street cars.

June 25.—At Kenora, Ont., Robert Neilly, a C.P.R. brakeman, caught his foot in a frog and was knocked down by a passing train. He will probably die.

At Gravenhurst, Ont., Harry Kinsella, aged 26, was killed in the G.T.R. yards whilst crawling under a freight train.

June 28th.—At Nothchill, B.C.—five laborers were killed in a freight wreck, caused by broken flange. A sixth was seriously injured. All were stealing a ride.

At Georgetown Junction, Ont., a man named Stevens was killed by a passeneger train whilst driving across tracks.

At Montreal, Paul Struble, 11, was knocked down by a street car and slightly injured.

Near East Toronto, Charles Wright, a driver, crossed the G.T.R tracks at an unprotected level crossing after a freight train going east had passed. The Montreal express, west bound, came along, killed his horse and smashed the wagon to pieces. Wright was rendered unconscious but recovered shortly after.

Near Hull, Que., Alphonse Laroque, run over by C.P.R. gravel train; left foot and thumb cut off.

June 29.—Near North Bay, Ont., a C.P.R. freight train was wrecked and 25 cars ditched; five hundred yards of track were torn up and five cars completely destroyed. Train hands escaped injury.

DESIGN OF ELEVATED TANKS AND STAND-PIPES.*

O. E. Selby.

This paper presents a desirable addition to the list of standard engineering specifications. Heretofore, specifications for structures included within the scope of the paper have been, to a great extent, the output of designers employed by manufacturers, and have shown the effects of the latter's bias.

If this discussion seems to be largely in the line of pointing out shortcomings in the author's specifications, it is not done in any spirit of criticism, but with a desire to see the specifications properly amplified and completed before they pass into a form which may be adopted as a standard. It is the writer's view that a technical specification should be something more than a mere check on the contractor; it should be a manual of design, complete enough to be a guide for the designer, whether he be employed by the purchaser or manufacturer, and should be so explicit and unambiguous as to permit of little discretion on the part of the designer, to the end that two independent designers working from it will produce substantially the same results.

The specifications seem to start with the assumption that the general dimensions of the structure are fixed. This should not be. For any given capacity and pressure there are certain economical ratios between height and diameter for elevated tanks, and there are other ratios for stand-pipes. Something relating to these rules of proportion should be included.

The specifications cover only stand-pipes and elevated tanks with hemispherical or flat bottoms supported on steel towers. One important form of elevated tank is ignored, that is, the tank with a semi-elliptical bottom and a small stand-pipe extending from the bottom to the ground, which serves both as a partial support for the tank and as a frost-proof inlet. This form is used largely for railroad water-station tanks, and the features which are peculiar to it should be included in this manual of design.

It is convenient to assume the weight of water at 62.5 lb. per cubic foot, because this makes convenient figures for calculation, namely, 8⅓ lb. per gallon, and 7½ gallons per cubic foot. The use of two-thirds of the exposed area for computing wind pressure on cylindrical tanks is better practice than the use of one-half, as is done in many specifications. This ratio should be extended also to conical surfaces.

Table 1 allows a tension of only 12,000 lbs. per square inch in tank plates, while a tension of 16,000 lbs. per square inch is allowed in other parts of the structure. This is in

* Discussion on Mr. Birch Noid's paper before the American Society of Civil Engineers, appearing in vol. xxxv, No. 5.

accordance with common practice, and gives good results, although there is no apparent justification for the reduced unit stress. The tank plates are just as strong as structural shapes, and the loads coming upon them are just as capable of exact calculation. Of course, the ordinary reason for using a reduced unit stress is to provide extra section to cover corrosion and other forms of deterioration. It would seem more rational to provide for this by an arbitrary addition to the thickness computed from the static pressure and net section. In fact, the writer has found it desirable and not any great hardship to specify an additional thickness of 1-16 inch for tanks designed for a unit stress of 12,000 lbs.

The allowable shear on rivets is given as 12,000 lbs., with no stipulation that there shall be any reduction of this unit stress for rivets in tank plates. If the tank plates are designed for 12,000 lbs. per square inch in tension, the rivets certainly ought to be designed for proportionately low unit stresses in shear and bearing. The allowed shear on field rivets and bolts is lower than that usually permitted. It is customary to prescribe that the number of field rivets shall be increased 25 per cent. more than the number required for shop-driven rivets. On this basis the shear in field rivets would be 9,600 lbs. per square inch instead of 9,000 lbs.

No information is given in the specifications as to the efficiency of riveted joints. This is an important feature in designing tanks and boilers, as the computations, usually are made directly on the basis of the efficiency of the joint, rather than by the more indirect process of computing the net section. It would be desirable to include a table showing the computed efficiencies of single- and double-lapped joints and single-, double-, and triple-riveted butt joints for various thicknesses of plates and diameters of rivets. Such tables are used by every manufacturer, and are published by some of them.

The use of the percentage of efficiency in the joint results in a simple formula for determining the thickness of plates in tanks subjected to hydrostatic pressure. Thus, if D = the diameter of the tank, in feet, H = the height, in feet, from the point considered to the surface of the water; the pressure, in pounds per square inch = 0.434 H. The tension in the plate for 1 inch in height = t = 2.6 D H. The required net area of the plate for 1 inch in height = A = t ÷ f, f being the unit stress, in pounds per square inch of net section. For f = 13,000 A = 2.6 D H ÷ 13,000 = 0.0002 D H. For an efficiency of two-thirds in the riveted joint, the gross area in 1 inch of height = the thickness of the plate, in inches = A ÷ ⅔ = 0.0003 D H. To this should be added the additional thickness of 1-16 inch already referred to. This formula, thickness of plate = 0.0003 D H, makes a convenient and rapid method of determining the thickness of tank plates. For a unit stress in tension of 12,000 lbs. the same formula results, if an efficiency of 72 per cent. is assumed.

It is customary to design on a basis of efficiency of at least 66 per cent., and that would rule out all single-riveted lap joints. Section 14 specifies lap joints for vertical seams in plates ⅜-inch thick and less, but does not specify whether they shall be single or double. They should be specified as double-riveted, with the possible exception of ¼-inch plates, in which the full strength of the plate is not developed. Double-riveted butt joints with the rivet diameters specified in section 15, will secure an efficiency of at least 70 per cent. up to and including a thickness of ¾-inch. For that reason it would seem desirable to design for an efficiency of 70 per cent., and specify triple-riveted butt joints for plates having a thickness of 13-16-inch or more.

The unit stress in compression should be limited to a maximum of 15,000 lbs. for short columns.

Section 10 is ambiguous in that it allows unit stresses of 20,000 lbs. in bracing, without specifying whether the unit stress referred to is for tension, compression, shear, or bearing. It gives a desirable addition to the bracing—which otherwise may be designed too light—to assume an arbitrary initial stress in all bracing members of 5,000 or 10,000 lbs.

Section 12, specifying that plates forming the sides of cylindrical tanks shall be of different diameters, is not explicit. Of course, it means that the inside diameter of one plate shall be the same as the outside diameter of the next one.

In Section 13 it is not clear just wheat is meant by radial seams in a spherical bottom.

Section 16 specifies that plates more than ⅝-inch thick shall be sub-punched and reamed, but does not specify the diameter of the punched hole and the amount to be removed by reaming.

Section 29 gives a rule for proportioning the stiffening member around the top of the tank, and specifies that the section modulus may be reduced under certain conditions, but does not specify definitely to what extent it may be reduced.

Section 35 allows an additional height of 6 inch for overrun. This is not clear. Presumably the meaning is that 6 inch in height shall be added to that required for the specified capacity in gallons.

Section 36 specifies that the bracing in towers shall be adjustable. Certainly riveted bracing for towers is better practice, although adjustable bracing may be allowable, on the score of economy, and the riveted bracing should not be excluded.

Section 37 specifies unit stresses in the anchor-bolts not exceeding 15,000 lbs. per square inch. Presumably, this refers to unit tensile strength, but it is not explicit. There is no specification covering the excess of the area at the root of the thread, and no specification which would produce good details in the design of the anchorage connections. Too many anchor-bolts are connected simply through the base plate of the column without provision for developing properly the full strength of the bolt, and this should be covered by a specification which will insure a good detail.

Section 38 specifies concrete sufficient in quantity to take the uplift, but does not provide any factor of safety. It is good practice to provide at least 1½ or two times the computed uplift in the weight of the concrete. Furthermore, the specification should include a provision that the arrangement of the anchorage in the concrete shall be such as to develop the full weight without depending on the tenacity of the concrete to hold the mass together; otherwise, this provision is apt to be overlooked, thus resulting in bad practice.

Sections 40 and 41 specify that the quality of materials and workmanship shall be according to certain specifications referred to by name. It would add little to the bulk of these specifications and much to their completeness if the specification for quality of materials and workmanship were written out in full.

(Continued on Page 22.)

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

Copies of these orders may be secured from the Canadian Engineer for a small fee.

7279—June 1—Authorizing the Essex Terminal Railway Co. to take additional lands for the purpose of alterating its line at the Windsor Fair Ground and Driving Association, Windsor, Ont.

7280—June 18—Ordering the C.P.R. early in the spring of each and every year, and before the water commences to run, to clear away any ice and snow that may have formed during the winter months underneath the bridge over Buffalo Lake on the north-east quarter of Section 32, Township 2, Range L, west first principal meridian, Manitoba.

7281—June 18—Directing the Canada Atlantic Railway (G.T.R.) to provide a suitable crossing where the company's railway abuts the land of Thos. Wilson, in the County of Carleton, Ont., near Ottawa, Ont.

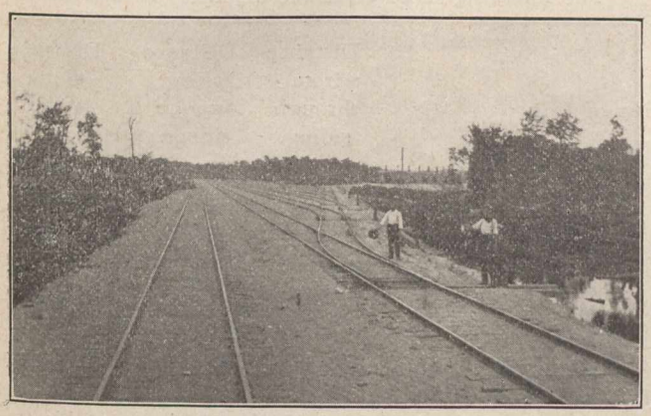
7282—June 18—Approving by-law of the Salisbury and Harvey Railway, authorizing A. Sherwood, general manager for receiver, to prepare and issue tariffs of tolls to be charged for all or any tariffs carried by that company.

(Continued on Page 17.)

THE LAYING OUT OF THE TRACK IN THE MUSKOKA DIVISIONAL YARD.

C. D. Norton.

For many years the Canadian Pacific Railway did not have direct connection between Toronto and the district Toronto represented and Western Canada. It is true they had a traffic agreement with the Grand Trunk Railway by which they used the Northern Division of the Grand Trunk



Muskoka Yards, Looking North.

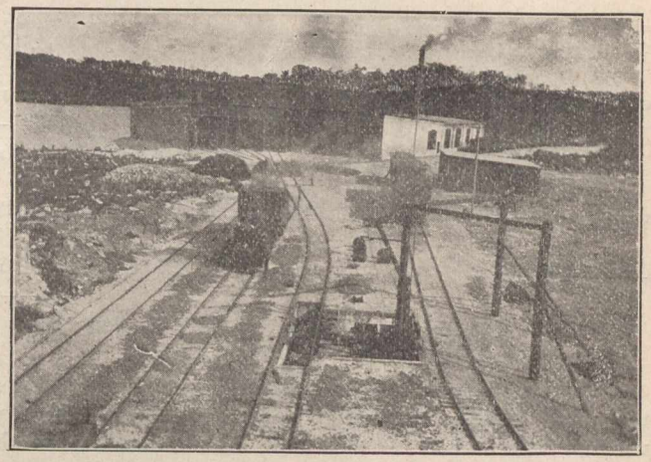
to North Bay, but in 1902 the C.P.R. decided to build a line connecting Toronto directly with the West, which, when built, became known as the Toronto-Sudbury branch of the C.P.R.

This article deals with the laying out of Muskoka, the only division point on the line.

Nothing new or of any scientific importance will be found in the following article, but it may be helpful to those who have not had much experience with trackwork, especially if they are required to produce results in a hurry.

is in practical work all settled beforehand, and governed by standard rules. It need only be taken into consideration in special cases, as when one switch follows too closely upon another or when a turnout is on a curve. When once a starting-point is established it will be found better to ignore centres and use the gauge line of the rail, and set all stakes to it, which will bring results ready for the foreman.

When possible it is advisable to reference points so that



Ash Pit, Oil House and Round House, Muskoka.

if necessary they can be picked up with a tape, either by the engineer or the foreman. The latter should be watched, though; the average is far from accurate.

In the yard under consideration a large part of the sub-grade was built by train-fill, and the above method was found very useful, every second or third frog being, of course, checked with a transit.

Before any frogs are set it is advisable to check the angles, as sometimes a No. 7 proves to have a 6¾ or 7¼ spread, and any found to be wrong should be put in where

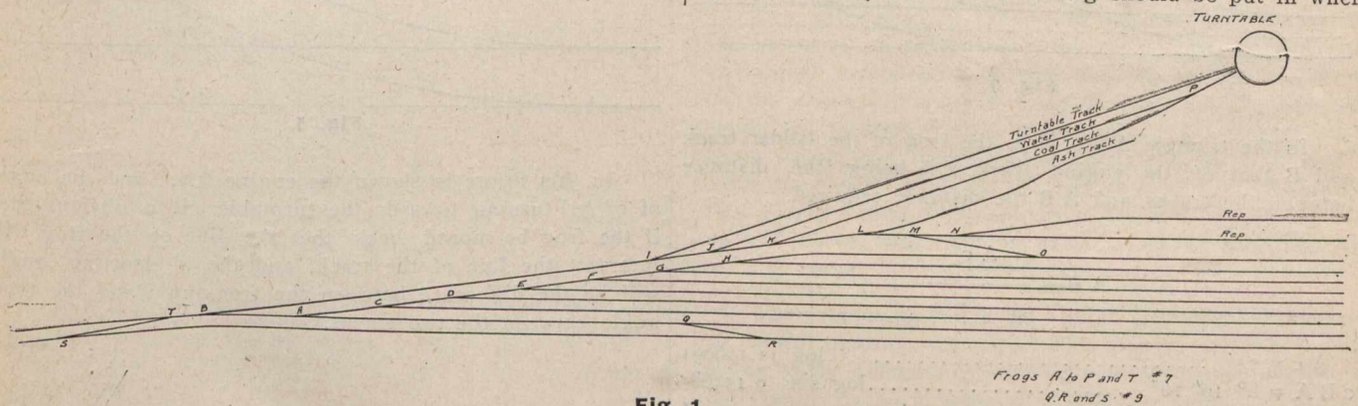


Fig. 1.

The writer was provided with a plan of the proposed yard, shown in sketch (Fig. 1); this was drawn to a scale of 50 feet to an inch, and it gave only the distances between tracks, and the chainage of the P.I. of the ladder track and the through siding. Quite contrary to the usual procedure of railway construction, the plan arrived some time before the work was required to be laid out, thus allowing ample time for experiment; but it would be only fair to mention that the time-honored custom was not forgotten, and, at a later date, the location of one of the tracks was altered, necessitating the relocation of the adjoining switches.

The layout of a series of switches seems very simple on paper, but the stakes on the ground are puzzling enough to the man who set them there, and to the foreman they are meaningless until he is shown exactly how the switches are to run. Care should be taken to leave in only such stakes as the foreman can conveniently work from; practically all that he needs is a stake set at the actual point of frog and an occasional centre. If too many are put in he will most certainly mistake them and evolve some very peculiar and expensive results. All details regarding the lining of the lead-out curve and other minor details are best left to the foreman, as that is his business. The length of the lead, although dealt with very thoroughly in text books, it will not be in conjunction with another frog. They should never be used on ladder tracks, but can sometimes be put in a cross-over if due allowance is made.

After a careful perusal of the plan, a thorough search was made through the available text and note books, and it was found that these gave only the theory, with little or nothing of practical work, especially regarding split switches. Those books published for the guidance of trackmen were certainly more useful, but, of course, instrument work is not touched upon in them.

The following are the principal problems involved and their respective solutions:—

The P.I. of the ladder track and the through siding was established according to the chainage, and the point of frog was found as shown by the following sketch:—

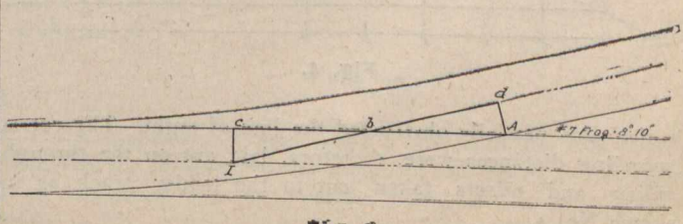


Fig. 2.

The two triangles I c b and A b d are similar, and it is necessary to find c b and b A, the perpendicular and the hypotenuse, respectively, the base c I or d A and the angles c b I and d b A being known.

$$c\,b = \tan \frac{c\,I}{c\,b\,I} \qquad b\,A = \sin \frac{d\,A}{d\,b\,A}$$

$c\,I = \frac{g}{2} = 2.354$ ..... log 10.371806

$c\,b\,I = 8°\ 10'\ 16''$ .....log tan 9.157116

$c\,b = 16.394$ ..... log 1.214690

$d\,A = \frac{g}{2} 2.354$ ..... log 10.371806

$d\,b\,A = 8°\ 10'\ 16''$ .....log sin 9,152685

$b\,A = 16.563$ ..... log 1.219121

$16.394 + 16.563 = 32.957 = c\,A.$

To this distance must be added the difference between the actual and the theoretical point of the frog. Frogs are usually ½-inch thick at the point, which would make this distance in a No. 7 to be 3½ inches, or .292 of a foot.

$32.957 + .292 — 33.249$, or 33.25.

This distance was set off on the centre line and the rail marked at right angles for the first frog on the ladder track, numbered A. The next frog to be set was that for the engine track, No. B, which was parallel to and 15 feet distant from the ladder track.

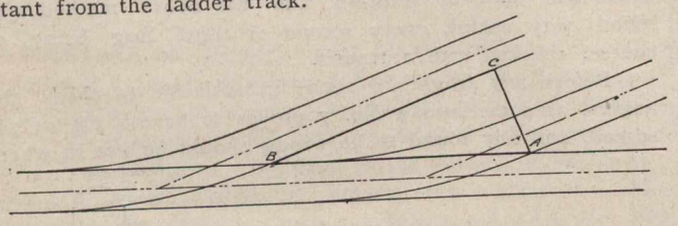


Fig. 3.

In the triangle A B c, A is the frog of the ladder track and B that of the engine track, c A being the distance between the tracks and A B the distance required.

$$A\,B = \frac{A\,c}{\sin c\,B\,A}$$

$A\,c = 15'$ ..... log 11.176091

$c\,B\,A = 8°\ 10'\ 16''$ .....log sin 9.152685

$A\,B = 105.54$ 2.023406

Which distance was laid off and a stake placed at B.

The next proceeding was to lay out the frogs on the ladder track, lettered C to H. The first method was to set up the transit over the point of frog A, deflect the angle, and lay off the various distances. This was found to be rather unpracticable, owing to the difficulty in measuring with a chain over piles of ties, rails, and other material,

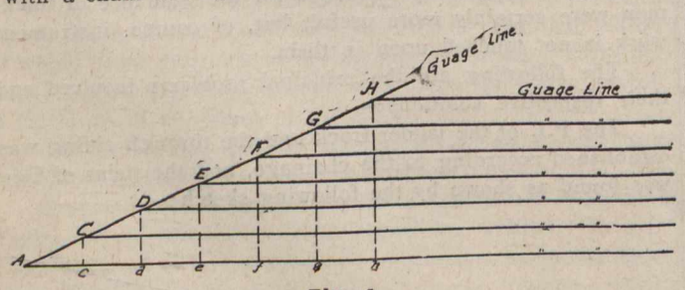


Fig. 4.

which also partially obstructed the line of sight. The corresponding distances were, therefore, laid out on the through siding and offsets taken out to the ladder track as in sketch No. 4.

The frog angle C A c, C c, D d, E e, the distances from the respective sidings being given—

$$A\,C = \frac{C\,c}{\sin C\,A\,c} \qquad A\,c = \frac{C\,c}{\tan C\,A\,c}$$

The similar triangles D A d, E A c, etc., being likewise solved, each one separately to avoid cumulative errors. Points were thus easily found with a fifty-foot tape.

The following table gives the distances as laid out:—

No. of frog.	Cs.	Distance from through siding.	Distance along through siding.	Distance along ladder track.
C	14	14	97.5	98.5
D	13	27	188.0	189.9
E	13	40	278.6	281.4
F	13	53	369.1	372.9
G	13	66	459.6	464.4
H	13	79	550.2	555.8

The south ladder track was staked out in similar fashion.

Opposite the end of the ladder track the turntable track turned off to the roundhouse, making an angle of 9° 31' with the engine track, and at the heel of the frog (I) about 25 feet of 3° curve is shown on the plan. This was rather a puzzler, but was solved in the following manner:—

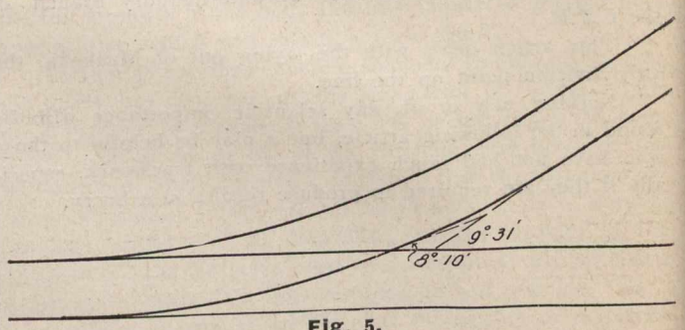


Fig. 5.

In this figure is shown the engine track and the angle of 9° 31' turning towards the turntable. It is obvious that if the frog be moved back that the line of the frog will intersect the line of the track, and the intersecting angle will be the difference between the frog-angle and the total angle between the two tracks.

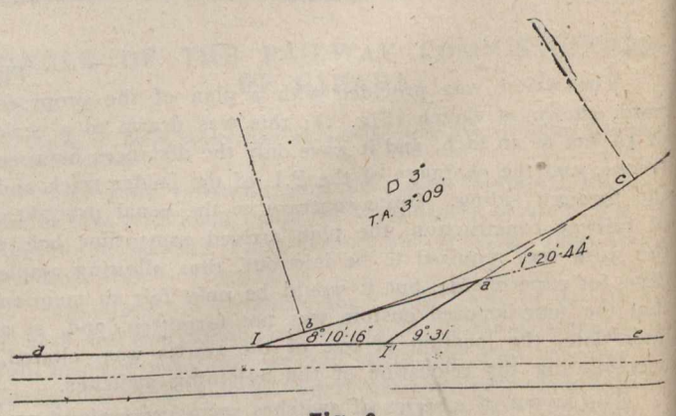


Fig. 6.

In the above figure d e is the line of rail of the engine track, c I' that of the turntable track, the point of intersection I' being found on the ground, which angle a I' d is 9° 31'. Let I be the position of the frog; then the angle I a I' = 1° 20' 44".

We find from the tables that the sub-tangent for a 3° curve with a central angle of 1° 20' 44" is 22.43 feet. To this distance add the length of the frog from point to heel, which in the present instance was 7.25 + .29, the difference between actual and theoretical points, which total is 29.97

In the triangle I a I′, being given the side a I and the angles a I I′ and I a I′, it is required to find the side I I′.

$$I\,I' = \frac{I\,a \sin I\,a\,I'}{\sin I\,I'\,a}$$

I a = 29.97 ..... log 1.476687
I a I′ = 1° 20′ 44″ .....log sin 8.370740
9.847427
I I′ a = 170° 29′ .....log sin 9.218363
I I′ = 4.256 ..... log .629064

On the gauge of the engine track this distance was laid off **back** from the intersection point, giving the point of frog one for the turntable track.

The frog points for the water and coal tracks, numbered respectively J and K, were staked according to the table, the hypoteneuse distance being used. Then came about the alteration in plan which has been mentioned. The distance between the turntable and water tracks, originally 14 feet, was changed to 15 feet. This would require that the distance between frog points J and K should be 105.6 instead of 98.5, and the point K moved ahead 7.1 feet. This could not be done, owing to the fixed position of Frog L leading on to the repair track, which point was found by intersecting the gauge-lines of the engine and repair tracks. By allowing the shortest possible distance between heel of frog and point of switch the frogs J and K were both moved back towards I, so that only a surplus of 0.5 feet was left. This was eliminated by shortening the lead of Switch L.

Point of Frog M was next set by allowing the switch to lead off at a convenient distance from the heel of Frog L, and Frog N staked similarly.

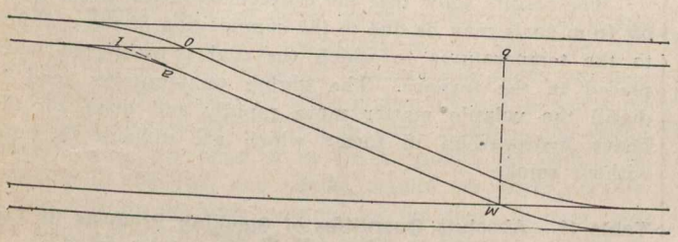


Fig. 7.

The cross-over from Frog M to Frog O was laid out as follows: The transit being set on Frog M, the angle 8° 10′ was deflected and an intersection made with the gauge of siding No. 8 at I′.

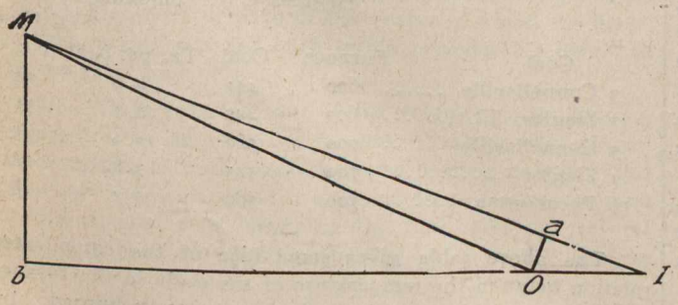


Fig. 8.

In the triangle a O I given a O and the angle a I O it is required to find O I.

$$O\,I = \frac{a\,o}{\sin a\,I\,O}$$

a O = 4.708 ..... log 10.672836
a I O = 8° 10′ 16″ .....log sin 9.152685
O I = 33.13 ..... log 1.520151

This distance (3,373 feet) was measured back from I on the gauge line setting the point of Frog O. The method of measuring b O as given in text books is only applicable when the parallel tracks are already in and level to centre. If no instrument is available, the point can be accurately set by measuring the three sides of the triangle M b, M O and b O.

In the triangle M I b the perpendicular M b and the angle M I b are given it is required to find the side b I.

$$b\,I = \frac{M\,6}{\tan M\,1\,6}$$

b 1 = 26′ 4.70 = 21.3 ..... log 11.328380
M 1 b = 80° 10′ .....log tan 9.157116
b 1 = 148.34 ..... log 2.171264
b O = b t — O_1 = 148.34 — 33.13 = 115.21.

In the triangle M O b—

$$M\,O = \sqrt{M\,6^2 + 6\,O^2}$$
$$= \sqrt{(21.3)^2 + (115.21)^2} = 117.16$$

For Frog P the transit was set over the centre of the pit and the frog angle deflected from the centre line of the turntable track; then the gauge line was offseted and an intersection made with the gauge of the water track, the distance being checked as per table.

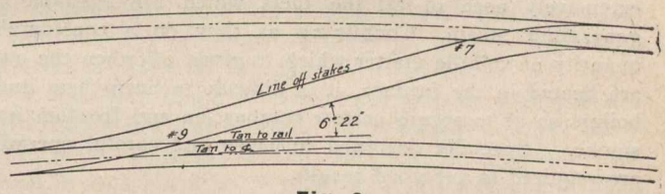


Fig. 9.

The cross-over on the south side of the station was staked out as on repair track, but the one on the north end was rather complicated. These cross-overs were not shown on the original plan, and Frog H came on the easement curve, so, to simplify the laying out, it was considered as being on tangent, necessitating about a hundred feet of 2° curve to connect with the central curve of 3°. Afterwards this proved rather awkward, as it brought the siding frog on a 2° curve, with 16½-foot centres and the main line frog on a 3° curve with 15-foot centres.

There appeared to be no simple mathematical solution, so careful platting was tried. This was not quite a success, owing to the difficulty of working with such small angles and flat curves, as, on a scale of 10 feet per inch, a 2° curve is practically a straight line. Recourse was then made to a method of trial and error in the field. Centre stakes were set on each of the two curves, 10 feet apart, and at the probable position of frogs the gauge of rail was laid out every two feet by ordinates offset from the 10-foot chords, and the Frog S set at a safe distance from the switch points on the siding. A tangent to the 3° curve at the centre opposite the point of frog was run and a parallel line offset through the same point, from which the frong angle 6° 22′ was deflected, as shown in Fig. 9, and stakes set to sight by.

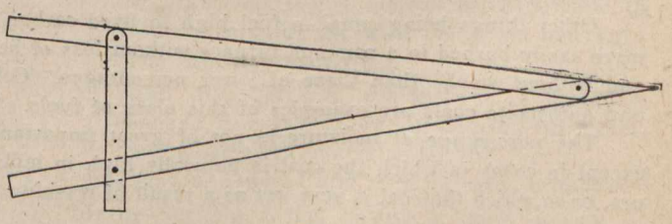


Fig. 10.

A frog-board, adjustable to a spread of 1′.7 and 1′.9 was moved too and fro on the gauge of the siding. The spread of 1′.7 fitted best at a certain point, and a stake was set for a No. 7 frog, and carefully referenced. The distance

between frogs has unfortunately been mislaid, but, being on a particular layout, is of no general importance.

The frog-board used at the time was a rough affair of three pieces of siding and three nails, knocked together with an axe. An adjustable one is shown in Fig. 8, the holes on the base being bored for the different angles. This will be found very useful in laying out frogs in difficult places, especially in conjunction with switches already in.

Although in the foregoing calculations the decimals run into two and three figures, this was done to avoid cumulative errors, and were by no means used on the ground, the nearest ½-tenth being accurate enough. If the track has to be laid on rough rock grade, as happened in this case, the engineer is lucky if he can get the resultant frogs and switches within a couple of tenths, and in case of doubt it is better to have the foreman err on the side of having the point of frog moved towards the toe instead of vice-versa.

THE RELATION OF THE CHARACTER OF COALS TO THE PREVENTION OF SMOKE.

By D. T. Randall.†

The semi-bituminous and bituminous coals are the most extensively used of all the fuels which are available for generating steam. Containing as they do a considerable quantity of volatile matter which is given off when the coals are heated in the furnace, it is difficult to burn them under boilers so as to secure perfect combustion and freedom from smoke. Specially designed furnaces and careful operation are required to get good results.

The difference in the character of coals is only partly shown by the proximate analyses which are commonly used, but to one familiar with coals these analyses indicate in a general way the leading characteristics of the coals.

To show the difference in fuels the following table has been prepared:—

Table I.—Analyses of Fuels as Delivered and Used.

	Coke	Anthracite pea coal	Pocahontas coal	Pittsburg coal	Indiana coal
Moisture	4.67	4.75	1.12	2.48	9.62
Volatile matter	2.82	2.90	17.24	38.74	36.14
Fixed carbon	82.61	77.15	74.84	49.18	41.22
Ash	9.90	15.20	6.80	9.60	13.02
	100.00	100.00	100.00	100.00	100.00
Sulphur	.....	0.80	0.71	1.85	4.43
B.t.u.	12206	11886	14530	13172	11122

It will be noted that coals vary both in their composition and in their heating values (B.t.u.) and in consequenee they are more or less valuable as fuel, depending on these variations.

Other things being equal, a fuel high in fixed carbon is more easily burned in a common furnace without loss of heat and without smoke than those of lower percentages. Coke and anthracite coals are examples of this class of fuels.

The percentage of moisture is not of great importance except in cases in which the coal is naturally high in moisture, or in which the coal is very wet as a result of washing or exposure to storms. Moisture in small percentages seems to aid combustion, but in larger amounts it retards the ignition of the gases and lowers the furnace temperature. It may or may not increase the smoke, depending on the character of the fuel.

The percentage of ash and especially the character of the ash is of importance in connection with the smoke problem. Ash which is fusible and runs down on to the grate bars may cause smoke by shutting off the flow of air through the fuel, and by increasing the poking which is necessary to keep the grates free. Coals which clinker badly require more attention from the firemen and poking the fire is a common cause of smoke.

There is a great difference in the behaviour of the same coals when burned under different furnace conditions, and in different furnaces. Some grates and stokers are adapted to handle coals which are burned with great difficulty on other equipment.

The rate of burning per square foot of grate is often the deciding factor as to whether a given coal may be used or not. This is principally due to the higher temperatures which are obtained with high rates of combustion, and its effect on the fusible portion of the ash of the coal. Investigations are now being made to determine the characteristics of the ash of representative coals as related to the clinker formed at various temperatures.

So far as smoke is concerned the volatile matter is of the greatest importance. The quantity of volatile matter is not a true measure of the difficulty of burning a coal, but to one familiar with the various coal fields it is of great assistance in choosing a suitable coal or in designing a furnace suited to the given coal.

Investigations relating to the nature of volatile matter in representative coal have been carried on at the Government Fuel Testing Plant, at the University of Ohio and at the University of Illinois.

The results show that the differences in the gases given off from coals may be due to the composition of the coal and to the temperatures to which the coal is subjected when placed in the furnace. The higher temperatures tend to distill the volatile matter more rapidly and drive off the heavy hydrocarbon in forms which are difficult to burn without smoke.

Table II.—Absolute Quantities of Smoking Products in Ten Minutes Heating at Different Temperatures.*

* See paper by Porter & Ovitz in Journal of American Chemical Society, vol. xxx.

	Temperature Degrees C		Smoking Products	
Coal	Furnace	Coal	Tar per cent.	C_6H_6 – c.c.
3 Connellsville	600	441	4.9	61
1 Ziegler, Ill.	600	440	6.8	51
3 Connellsville	700	562	11.0	145
1 Ziegler	700	545	7.8	24
16 Pocahontas	700	599	4.2	138

The above table gives some idea of the complicated relation between the temperature of the coals in the furnace and the compositions of the various gases to be burned. Investigations of this character are necessary to determine the characteristics of coals from each of the representative beds.

The combustion of coke or other fuels high in fixed carbon is comparatively simple. The greater portion of the fuel is burned on the grate; the remainder in the form of gas burns at a short distance above the bed of fuel. This may readily be observed on a fire of anthracite coal in which there is only a small percentage of volatile matter.

In burning bituminous coals, however, the difficulties are much greater and for the reasons given above. The volatile matter from some coals is set free more readily than from others, and with some coals the nature of the volatile

* Presented at the Syracuse meeting of the International Association for the prevention of smoke, June 24-26, 1909.

† Engineer in charge of Fuel Engineering Department, Arthur D. Little, Inc. Laboratory of Engineering Chemistry, Boston, Mass.

matter given off is such as to make it very difficult to secure complete combustion. Smoke is an indication of incomplete combustion and the problem of reducing the amount of smoke is important, not only from the standpoint of the smoke inspector, but also because of the losses in combustible gases such as carbon monoxide (CO) and hydrogen which escape with the smoke.

Table III.—Showing Relation of Smoke to CO in Flue Cases.*

Average per cent. of black smoke	0	7.1	15.5	24.7	34.7	43.1	52.9
Average per cent CO in flue gases	0.05	0.11	0.11	0.14	0.21	0.33	0.35
Number of Tests averaged	37	18	56	51	36	17	4

Experiments by several investigators have shown that whenever smoke is given off there is also a considerable quantity of carbon monoxide gas, and that as a rule this gas is accompanied by small percentages of hydrogen and hydrocarbon compounds. The losses due to these combustible gases which are found in connection with a smoke stack may vary between one and ten per cent. of the fuel.

Table IV.—Showing Relation Between CO in Flue Cases and Other Combustible Cases.†

	Smoky				Clear.			
Boiler Furnace	CO_2	CO	CH_4	H_2	CO_2	CO	CH_4	H_2
Hand Fired .	10.95	3.00	0.70	3.23	8.15	0.0	0.0	0.0

When burning a bituminous coal, the volatile matter must be raised to a high temperature while mixed with a sufficient quantity of air and burned on its passage from the fuel bed to the surfaces of the boiler. In most boiler settings this distance for combustion is very short and when the gases strike the cold surfaces of the boiler shell or tubes they cool below the temperature at which they will burn rapidly, and as a result some escape unburned and others are only partially burned, as shown by the heavy deposits of soot. In properly designed furnaces the space provided for combustion is large for coals giving off high percentages of volatile combustible. Even in such furnaces the firing must be carefully done or at times enough air cannot be supplied to the gas, and smoke results for short periods. In most plants the time required for the gases to pass from the fuel bed to the top of the stack is between 10 and 15 seconds, assuming the velocity to be reasonably uniform at different sections, then it will be seen that the gases pass from the fuel bed to a distance of say 12 feet in one second. At the end of this period there is but little opportunity for the gases to burn. This will make clear the great importance of a sufficient air supply, properly distributed, and an ample space above or back of the grates in which the gases may thoroughly mix and burn within considerably less than one second of time.

That there is a loss due to the volatile gases escaping unburned from an ordinary furnace is shown very clearly by the results of tests made on house heating boilers. The following table gives figures obtained on two series of tests for the purpose of determining the fuel values of several coals and briquettes,* when burned in a house heating boiler.

Table V.—The Relation of Volatile Matter of Smoke and Unconsumed Cases.

Number of tests Averaged	Volatile matter in the combustible	Ash in dry Coal	Efficiency	Black Smoke	CO in dry Flue Gases
4	18.30	8.00	60.56	18.2	0.44
12	22.71	8.94	56.33	18.0	0.50
7	34.70	11.27	54.11	22.1	0.55
11	38.79	15.02	47.19	30.8	0.62
16	44.46	14.57	47.19	32.9	0.74

The furnace in which the results shown in Table V. were obtained is best suited to coke, anthracite, or low volatile coals, and, as will be seen, is not adapted for burning bituminous coals, with good efficiency, yet many furnaces having practically the same features, such as a grate surrounded by heating surface, and a small combustible chamber, are used in power plants for burning high volatile coals.

Even with furnaces of improved design it is difficult to charge the coal by hand firing and secure smokeless combustion. This is due to the fact that a comparatively large quantity of gas is liberated immediately after firing, at the same time the fuel bed has been thickened and the air enters with more difficulty and without being well distributed with respect to the gases rising from the bed. With such a furnace the loss of combustible gases may be reduced to 5 per cent. or less depending on the coal and the operation.

It is because of the advantage in having the coal gradually heated and the gases distilled from it at a low temperature that a mechanical means of feeding the coal to the furnace is usually more successful in the prevention of smoke.

A good furnace should permit the burning of bituminous coal in sufficient quantities without loss of escaping gases or the formation of smoke when the air supply is about 50 per cent. in excess of the theoretical amount.

It has been found by experience that to approach this performance, the coal must be fed regularly in small quantities, gradually heated if possible, and the air supply admitted in such a way as to thoroughly mix with the distilled gases. Furthermore the space for burning the gases should be large and preferably enclosed in fire bricks.

A furnace suitable for certain coals may be entirely unsuited to other coals and it is only after a careful study of all the factors, such as power to be generated, size and kind of boiler to be used, and the coals available, that an engineer can undertake to design a furnace which will be satisfactory and at the same time give good economy under operating conditions.

Even after the best types of furnaces are installed it is necessary to supervise the operation of the boiler plant closely in order to secure the best results. The proper drafts, the best thickness of fire for any given coal when burned on grates at the rate required for the plant, and the best method for the removal of ash and clinkers to prevent loss of fuel into the ash pit are all factors in securing the highest economy. Failure to attend to these important details may easily cause a loss of as much as 10 per cent. in the fuel fed to the furnaces.

In conclusion:

1. Even well designed furnaces may be expected to give off smoke if improperly operated, or under any of the following conditions:
   - (a) When a new fire is built in a cold furnace.
   - (b) When an excessive amount of coal is burned on the grate, making it difficult or impossible to properly mix the air with the gases and burn them in the furnace.
   - (c) When the rate of combustion is suddenly changed, due to a change in demand for steam, for the same reasons as under (b).
2. Smoke may be reduced and in most cases prevented:
   - (d) By burning a fuel having a small amount of volatile matter.
   - (e) By burning a bituminous coal in a specially designed furnace with more than ordinary care on the part of the fireman under the supervision of a competent engineer.

* See United States Geological Survey Bulletin 325, pages 101 and 167.

† See Manchester (England) Smoke Abatement Report.

* See United States Geological Survey Bulletin No. 366.

THE
Sanitary Review
SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

VOLUNTARY ADVICE AND WINNIPEG'S SEWERAGE.

It has been said that one volunteer is worth three pressed men. That this is true, when expert advice is required, we are inclined to doubt. However, the city of Winnipeg is blessed with an association of gentlemen termed "sanitary" who think they can tell the corporation something worth knowing about the city's sewerage system. Probably they can. On the other hand, it appears doubtful that they can supply any information which the city council could not obtain from their paid officials.

A delegation from this association waited upon the Board of Works, with the simple request that they be allowed to inspect the main sewerage system, as it was suspected that a fair amount of filth was resting peacefully in the sewers, instead of moving forward.

It appears to suggest itself, that instead of wasting the time of an important body, such as the Winnipeg Sanitary Association on such a quest, it would have been easier to have got this information by at once despatching one of the officials of the sewerage department, who might have returned there and then with the necessary data.

This Sanitary Association appears to include several ex-aldermen. Herein consisteth the leven of busybodyism. An alderman never appears to take any practical interest in civic affairs until he obtains the ancient order of Ex. Out of the council he waxes wroth, and feels that civic legislation spells ruin without the benefit of his advice.

We take that this Sanitary Association is a sort of scientific ratepayers' association, composed of the men who would like to be, but are not.

This Sanitary Association may, however, be of value in bringing pressure upon the powers that be, and making the blind see. They may remind the present aldermen that the title of Ex is awaiting them also if they do not make a move.

From all accounts it appears certain that the city of Winnipeg has outgrown its present sewerage system. Five years ago an expert was called in to give an opinion on the then condition. To-day, Winnipeg is an entirely different propostion from what it was five years ago.

Winnipeg corporation will adopt a sound policy in having a thorough survey and inspection of its present sewerage system, together with a report as to improvements necessary to meet present and future requirements and prevent further pollution of the river from the present untreated foul discharges.

SEWAGE DISPOSAL AND DISINFECTION.*

Sir James Crichton-Browne, M.D., LL.D., F.R.S., in his address the other day to the International Congress of Applied Chemistry (Section of Hygiene), has some interesting remarks to make on the biological system of sewage disposal as follows:—

Are we at present engaged in perpetrating another failure at a still more exorbitant cash outlay? I think not, for the bacteriological system is not an empirical or isolated or haphazard experiment, but an evolutionary growth and an imitation of Nature, which never fails. It is a reversal of most previous systems in that it seeks not to arrest but to promote decomposition. Originating in the discovery of the illustrious Pasteur in 1862 that putrefaction is the work of micro-organisms, and advanced by the observations of Schlosing and Muntz in 1877 that nitrification is accomplished by the agency of bacteria, it did not take practical shape until the experiments of the Board of Health of Massachusetts were instituted in 1888. Thereafter it owed its development to Scott Moncrieff, who in 1892 introduced his cultivation tanks and nitrification channels, and subsequently attempted to secure greater aëration of the effluent by various devices Following him came Dibdin with his downward filtration through coarse filter-beds, and later with his contact beds, and Mr. Donald Cameron, of Exeter, with his septic tank, which still, with many additions and modifications, holds the field.

The bacteriological system has by no means reached its final stage. It is being improved daily, and we may look for an increase of its efficiency to the constant observations of a number of highly scientific and able Medical Officers of Health, to the analyses of our chemists in their laboratories, and to the recommendations of the Royal Commission on Sewage Disposal which has been sitting in this country since 1898, and which still continues its deliberations. But while many refinements in the bacteriological system may be expected and many adjustments of it to varying local requirements and the particular quality of the sewage to be dealt with as affected by trade refuse and in other ways, the fundemental principles underlying it are, it seems, established. It is now certain that the sewage of a great city, amounting, perhaps, to thousands of tons and loaded with animal and vegetable waste products, can be effectually and inoffensively disposed of by anaërobic and aërobic bacteria and reduced to their original inorganic elements. Our dependence, it is said, must henceforth be placed in a tank and a heap of cinders.

The theory and practice of sewage treatment by bacterial methods is fully set forth in the text books on the subject. I am not acquainted with those of the Continent, but I can say that in this country we have fortunately admirable and lucid expositions in the works of Dr. Rideal, Dr. Barwise, and Mr. Martin, while the United States can boast of an inimitable summary in the Reports of the Massachusetts Institute of Technology. It would be disrespectful to your knowledge and intelligence were I to attempt a résumé of what they set forth, while as for what may be called the moot points in the system, the new developments, the recent mechanical improvements. these will be brought before us in the several papers to which we are to be privileged to listen. We shall, I have no doubt, hear something of the dangers of spraying septic sewage, and so wafting pathogenic streptococci abroad; of the determination of the rate of oxygen absorption by sewage of different qualities, of the different standards of sewage effluents; of the relative advantages of different kinds of sprinklers and distributors, and of coarse and fine grain, and deep and shallow filter-beds, of the use of methylene blue in testing sewage effluents; of the hydrolysis advisable for sewages of various strengths, and of the danger pointed out by our vice-presi-

* Presidential address delivered at the International Congress of Applied Chemistry (Section of Hygiene), May 28th, 1909.

dent, Dr. Kenwood, of sewage becoming over-septicized if left too long in a septic tank, resulting in a deposition of colloid matters which interferes with the working of the tank.

On none of these topics must I touch, but there is just one question raised by Dr. Barwise, who brings ingenuity, insight, and exact methods to the study of all sewage problems, to which I should like to allude. He has recently contended that bacterial beds are not correctly so called. They are, in his view, entomological menageries stocked not only with bacteria, but with many varieties of animal life. He does not attempt to classify the animal inhabitants found in biological filters, but believes that in small grain filters, at any rate, the destruction of organic matter is mainly effected by small river worms. As there are about one thousand species of these he does not identify the principal operators, but has recognized the Naididæ and Tubificidæ in enormous numbers, and has satisfied himself that they are extremely prolific and very gregarious. Then there are innumerable Polychata, beautiful objects under the microscope, swimming about in every specimen of the effluent. In the coarse grain filters, on the other hand, there are large worms, leeches, and countless numbers of larvæ, of gnats and flies. The suspended matter in the effluent from these coarse grain filters consists almost entirely of the casts and eggs of worms and of the larvæ of flies. The effluent from the fine filters, besides minute river worms, contains the ordinary water crustacea, such as cyclops and cyprides and fresh water shrimps. There are, too, on the surface of the water hosts of water spiders, and lately Dr. Barwise has noticed centipedes, and on some beds a small, black, jumping insect like a flea, known as the Podura, which is present in such quantities that they can be wheeled away in barrow-loads. Dr. Barwise cannot understand why these comparatively large organisms present in such quantities should have escaped attention, while bacteria which only the microscope reveals have been the subject of concentrated study.

Dr. Barwise's observations and speculations are exceedingly interesting, and open up many and far-reaching vistas of research in connection with sewage disposal. Our filter beds, it appears, are not merely rendezvous for bacteria, aërobic and anaërobic, but an olla podrida of insects, spiders, crustacæns, leeches, worms, and protozoa, all contributing something to the final composition of the broth. We must ask our zoologists to inform us of the life history of each of these, of their food habits and digestic processes, and of their internecine wars, and we must invite our chemists to investigate the changes due to their presence, occurring during the process of biolysis, and the part they play, if any, in the purification of sewage.

In the meantime I think it would be well to continue to put our faith in bacteria, and to trust to their putrefactive and oxidizing power for the breaking down of organic substances in sewage into simpler molecular forms.

A NEW METHOD OF TREATING SEWAGE.

By K. Imhoff, Engineer of the "Emschergenossenschaft," in Essen, Germany.

(Continued from last week.)

The size of the subsidence tank or basin is solely dependent on the quantity of sewage to be dealt with and the period required for subsidence. No special allowance need be made for possible accumulation since the working need never be interrupted. Neither is it in most cases necessary to make allowance for increase in the bulk of the sewage by rain water; the tanks can deal with sewage diluted by rain to from three to five times its normal bulk, the period required for purification being proportionally reduced. The subsidence and septic tanks are collectively no larger than ordinary subsidence plant. Moreover, inasmuch as the circular tanks can have very thin walls, the cost of construction is in most cases less than that of ordinary subsidence plant. The attention required is practically limited to the removal of the sludge drawn from the tanks. The working expenses are accordingly small, in the absence of all complicated apparatus.

The Tanks in Conjunction with Bacteria Beds.

Where the water freed from sludge is sufficiently dilute, and can be discharged into a well-regulated watercourse, no further purification is necessary. Otherwise, bacteria beds are provided. In such cases the tanks are used for preliminary purification. The tanks are specially suitable for this purpose, for the reason that the water is not contaminated.

Opinions on this point still differ, however. Nevertheless, the view that it is preferable to supply fresh water to a bacteria bed, as to a river, appears to be gaining the upper hand. The beds are in that case capable of more work—that is to say, they can be of smaller dimensions for given requirements. But apart from this, an important advantage derived from keeping the water fresh lies in the fact that fresh water spread on bacteria beds evolves much less odour than water containing sulphuretted hydrogen.

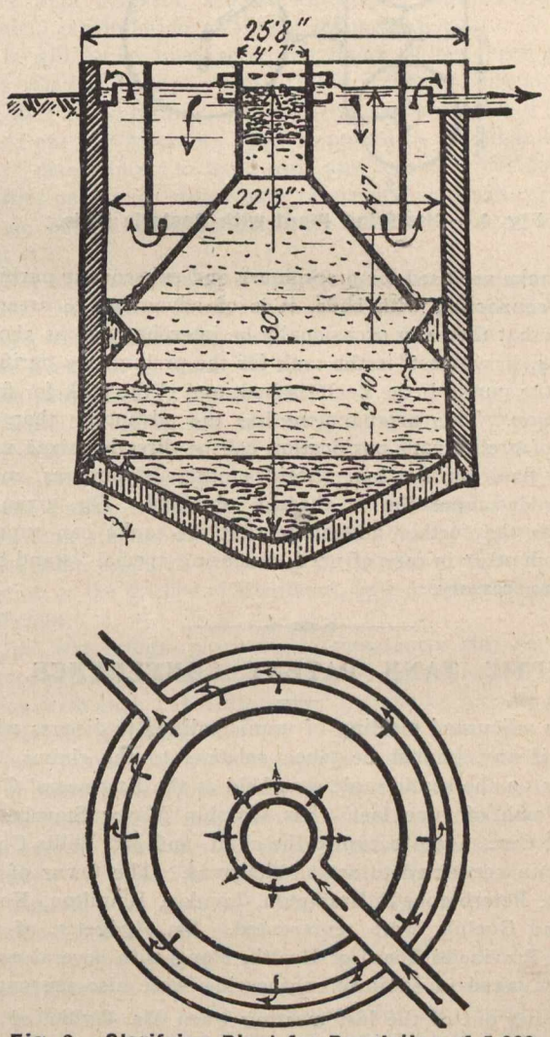


Fig. 3.—Clarifying Plant for Population of 5,000.

In England, too, there is an increasing tendency to avoid the use of ordinary septic tanks for preliminary purification on account of the odours arising therefrom. The known disadvantages of ordinary subsidence works are often preferred. A case in point seems to be that of Machynlleth, dealt with in No. 875 of The Surveyor.

It is in cases of this kind that the new system will prove of great advantage, the water being kept fresh and odourless, as in the subsidence treatment, and the sludge being dealt with as satisfactorily as in any septic tank.

In the case of percolating beds, it is usual to subject the discharge from the beds to a process of mechanical purification, in view of the large amount of sludge carried from the beds. The sludge separated by this purifying process is also capable of decomposition and has the same properties as the sludge separted by the preliminary purification. Emscher tanks can be used also for the treatment of the discharge from the beds, but in this case the subsidence tank must be de-

signed for only one hour of deposition, the sludge tank being usually about one-quarter of the size required for preliminary purification. The proportions vary, however, greatly.

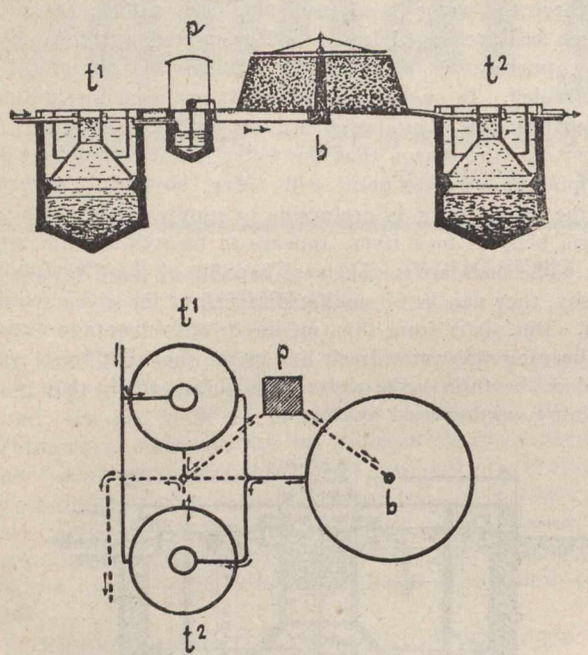


Fig. 4.—Clarifying Plant with Bacteria Beds.

If tanks are used for preliminary and subsequent purification in connection with beds, it is of advantage to arrange them so that they can occasionally be interchanged, as shown in Fig. 4, in which t^1 is the tank for the preliminary purification, p the pump, b the bacteria bed, and t^2 the tank for final purification. This arrangement has the advantage that the sludge of preliminary purification can be directly mixed with that of final purification. Besides other advantages, more uniform decomposition is thereby obtained. The arrangement has the further advantage that the tanks can supplement each other in case of need, rendering special "stand-by" tanks unnecessary.

SEPTIC TANK PATENT CONFERENCE.

The adjourned meeting of municipalities to discuss what action, if any, should be taken relative to the claims for royalties on the septic tank, was held at the Engineers' Club on the 24th of June last. His Worship Mayor Stavely, of London, Ont., again occupied the chair, and Mr. Willis Chipman again consented to act as chairman. The towns of St. Thomas, Peterborough, Brampton, London, Hamilton, North Bay, and Guelph, were represented. Dr. Hodgetts, of the Ontario Provincial Board of Health, along with several engineers, engaged in sanitary engineering were also present.

Arising out of the last meeting when Mr. Wyllie, of the Septic Tank Company read a statement with reference to the company's demands for royalties, Mr. Macallum, city engineer for Hamilton, called upon Mr. T. Aird Murray, C.E., to read a statement, which several engineers had jointly drawn up, replying to Mr. Wyllie's statement.

As we published the former statement in full in our issue of June 18th, we also publish the text of the engineer's statement which was duly read before the representatives.

The statement is as follows:—

To the representatives of the various municipalities interested relative to the question of claims for royalties in Septic Tank Patents.

We, the undersigned Civil Engineers, having attended a meeting of representatives of municipalities, held at the "Engineers' Club," Toronto, June 10th, 1909; and having heard a statement read at that meeting by Mr. Wyllie, of the Cameron Septic Tank Company, of Chicago, and having further examined the said statement in detail as printed, have met together, and after due consideration have concluded a reply thereto. This reply we have put in the form of a statement and duly signed as mutually agreed upon by ourselves.

We first briefly sum up the leading interesting points, which we consider of importance in Mr. Wyllie's statement:—

Points in Mr. Wyllie's Statement.

(a) Mr. Cameron first discovered the scientific principals of the septic process.

(b) That the process is a natural one, but as particularly applied, for the purposes of the elimination of sludge by putrefaction in connection with sewage disposal it is patentable.

(c) That the process has been patented both in the United States and in Canada.

(d) That the process may consist 1st, the so-called anaerobic action of putrefaction by means of which sludge is digested or eliminated. Or, 2nd, the above anaerobic action together with aerobic action, or a further treatment by oxidation of organic ammonia compounds either by means of land intermittent filtration or by means of specially constructed filter beds.

(e) That the main features of the septic process may be summed up in the words of Judge Lacomb, in his decision in the case of Cameron suit against Saratoga Springs, U.S. We quote part of this decision as follows:—

"We, however, are satisfied that Cameron was the first one to subject a flowing current of sewage to the action of anaerobes and aerobes under conditions which secured their separate and successive action. The action of the segregated anaerobes fitting the effluent for subsequent filtration, and aerobic action; and by reason of such careful segregation, he was the first to secure such specified conditions in the anaerobic colony, that its capacity for its natural work was increased to such an extent that it became capable of disposing of practically all future inflowing sludge sewage that entered its workshop without accumulating such a deposit of sludge as would require removal."

(f) That the patents for the above process have been held as valid in the United States.

(g) That no case has as yet been submitted to legal decision either in Great Britain or in Canada.

With reference to this statement, we agree that it is a fair statement of the position of the septic process in the year November, 1907, when Judge Lacombe gave his decision.

With reference to the legal aspect, however, as to how the patents might stand in British or Canadian law, we offer no opinion as we are not lawyers.

On the engineering and general aspect, however, we would offer several remarks, with reference, as follows:—

(a) We cannot agree that Cameron was the first to discover the scientific principals of the septic process. The Cameron process was patented in Great Britain at first in the year 1896. We call attention to the Forse Mouras designed in 1860, here the inlets and outlets are trapped and air excluded from the tanks.

All the putrescible solids were claimed to be liquefied in the tank by anaerobic fermentation allowing of only a slightly turbid liquid.

In 1876, Alexander Muller applied for patent rights for a septic process of tank treatment in which sewage was biologically treated. Air and light were excluded, but it was not claimed that the effluents were purified.

Again in 1891, Scott-Moncrieff constructed what he called a cultivation tank. The whole arrangement is merely a septic tank filled with stones. Scott-Moncrieff claims that he was the first in Great Britain to bring into practical operation any appliance for the claimed purpose of the liquefaction of sludge by putrefaction.

(b) That the process is a natural one, but as particularly applied, etc.

We gather from this and the wording of the United States decision, that there is no claim set up as to a monopoly of septic action. When septic action even in the case of sewage disposal is accidental, and is not particularly applied

for the defined purpose of sludge elimination, there appears to us to be no patent rights.

In the case of the old-fashioned cesspool, covered in and neglected, septic action certainly took place. Such tanks were, however, not designed for the special purpose of sludge elimination by putrefaction, but only as catch pits for solids. Again in many sewerage systems, when gradients are flat and pipes are large, the sewage takes so long to travel to the outlet and so much deposit is formed in the pipes, that septic action is set up in the sewers themselves, and the sewage arrives at the outlet in a highly septic state.

In the case of ordinary continuous flow, sedimentation tanks designed for sedimentation of solids only, by accident or neglect, they may be left unattended to, and septic action naturally is set up without any wish or consideration being given to the benefits, if any, of such action. We take it, that in all such cases no patent rights are implied.

(c) That the process is patented in the United States, in Canada, and in Great Britain also, is taken for granted, but we note that only in the United States has the question been subjected to legal decision. No royalties as such have been apparently collected in Great Britain, and we gather that this is also true in Canada, any payments as royalties appear to have been included or covered by the profits which the company has made in providing apparatus to their clients or in charges made as engineers for supervision of the works. In fact, the company advertise in their printed matter, that when they are directly employed, no royalty charges are made. It would appear, therefore, that there is no precedent in Great Britain or Canada for the payment directly of specific royalty charges.

(d) That the process may consist of: first, septic action only for the elimination of solids, and second, septic action combined with the well-known and understood methods of nitrification, which, of course, are in themselves unpatentable, and previous to the septic patents. This appears to be the meaning of the Saratoga Springs decision. Whether this means that the company can in addition to royalty charges, based on the cost of the septic tank, also claim royalty of the (by itself) unpatentable system of nitrification or aerobic action, when combined with the septic tank, we are not quite clear. If so, it appears a great hardship that royalties can be demanded not only upon the minor and less costly part of a sewage disposal plant, viz., the sedimentation tank, worked intentionally as septic, but also upon the most important and more costly part of the plant, viz., the filtration methods.

(e) The United States' decision in the Saratoga Springs case. This affirms the validity of the process patents.

We would here point out, however, that since this decision was given, further light has been shed upon the whole process of septic action and especially upon the chief benefits which the company claim are connected with the process.

How far any legal decision would be effected by the newer knowledge, we are not so versed in the law that we can give any opinion.

We will, however, here draw attention to the findings contained in the fifth report of the Royal Commission on Sewage Disposal, (Great Britain), the findings of which have recently been further substantiated by the long and careful experiments made at the "Hamburg State Institute of Hygiene," by Professor Dunbar, and further by many other competent and reliable authorities.

The Royal Commission state (page 21, par. 31.):

"The motion that the solid matter of sewage would be digested by passing the sewage through a sealed tank, is by no means novel, but it does not appear to have had any extensive practical application until Mr. Cameron, who held the office of City Surveyor of Exeter, proposed the adoption of the "Septic Tank Treatment" for that city.

"At that time it was claimed that the septic tank possessed the following, among other advantages:—

"That it solved the sludge difficulty, inasmuch as practically all the organic solid matter was digested in the tank.

"That it destroyed any pathogenic organisms which there might be in the sewage.

"That sewage which had passed through a septic tank was more easily oxidized than sewage from which the solids had been allowed to settle, either with or without the aid of chemicals, in tanks which were frequently cleaned out."

The Commission conclude on the above claims as follows, (page 229, par. 240):—

"All the organic solids present in sewage are not digested by septic tanks. The actual amount of digestion varying with the character of the sewage, the size of the tank relative to the volume treated, and the frequency of cleansing. With a domestic sewage, and tanks worked at a 24 hour's rate, the digestion is about 25 per cent.

"The liquor issuing from septic tanks is bacteriologically as impure as the sewage entering the tanks."

"Domestic sewage which has been passed through a septic tank is not more easily oxidized in its passage through filters than domestic sewage which has been subjected to chemical precitulation or simple sedimentation."

It will be at once seen that many of our preconceived ideas relating to septic tanks require considerable modification, and in the light of this further knowledge, it will be well to find out just where we stand in regard to the whole matter, before determining to hand over any fees to a company for royalties or patents which have received such drastic criticism by one of the most authoritative pronouncements we can point to.

Not only have the above points been lately substantiated, but Dr. Dunbar, of Hamburg, has shown that with Hamburg sewage, three times the quantity of ordinary sedimentation liquor over that of septic liquor can be treated satisfactorily on the same area of contact beds.

Septic action is not, however, altogether condemned by the Royal Commission, they state (par. 36, page 22):—

"It must, therefore, be said that some of the more important claims which were originally advanced in favor of septic tank treatment, have not stood the test of experience. At the same time, we think that in certain circumstances the adoption of the method of treatment, as a preliminary process, is efficient."

Just where these particular circumstances may occur is a matter of engineering and economic consideration in connection with each particular case. It may be broadly stated, however, as follows:—

(a) When it is not necessary to purify the sewage, but only to remove the grosser solids by precipitation and turn the sewage liquor direct into a source where any nuisance will be minimized by dilution, the benefit of the 25 per cent. reduction in sludge by digestion, may be taken advantage of, and the tank run in long periods without sludge removal and so maintenance cost kept down.

(b) In the case of small installations where the cost of maintenance is a serious item, tanks may be run for say, six to nine months, and the sewage liquor further treated in good open friable land or rough, coarse contact or percolating filters.

Otherwise than in such above cases it would appear desirable to remove the sludge before full septic action commences, say every two months, and convey it to sludge dug out drying beds made in the vicinity of tanks. This would not be necessary in winter, as with our climate practically no septic action takes place in the colder months of the year.

The present known advantages and disadvantages of septic treatment appear to be as follows:—

Advantages.

1st.—Elimination or digestion of about 25 per cent. of the sludge retained in the tanks by hydrolisis and gasification.

2nd.—A more solid form of sludge produced in the tanks containing about 80 per cent. of moisture as against 90 per cent. with ordinary sedimentation.

3rd.—The sludge digested into finer particles and less apt to produce a nuisance if used for reclaiming land or filling in purposes.

4th.—A saving in maintenance by the avoidance of frequent removal of the sludge.

Disadvantages.

1st.—A constantly increasing quantity of solids given off with the tank liquor as the process is continued. For example, at Burnley, (England), the suspended solids in the liquor varied from 15 parts per 1,000 after a few weeks working to 35 parts per 100,000 at the end of six months. At Huddersefild, (England), the amounts were 6.6 parts per 100,000 at the commencement, and 23.3 parts per 100,000 at the end of eleven months.

At Leeds from January to June, 1903, starting with a perfectly clean tank, the suspended solids averaged to 12.2 parts per 100,000, and from July to December, 1904, the average was 24.1 parts per 100,000, (see Royal Commission Report, page 24). In all of the above cases an increase of over double the amount of solids in the liquor in terms of less than 12 months.

2nd.—The increase of solids tends to choke the filters and render them useless after short periods of time.

3rd.—The effluent sewage liquor is highly charged with sulphureted hydrogen and causes nuisance from smell when sprinkled over filters.

Septic Tank Treatment as Compared with Ordinary Sedimentation.

1st.—Septic tanks may be run without removal of sludge for 12 months. Sedimentation tanks should be cleaned out at least once every month.

2nd.—Sedimentation tanks produce as far as the tank liquor is concerned, a liquor of less organic strength.

3rd.—In each case the removal of solids by sedimentation to commence with, is equal from 60 to 70 per cent. With sedimentation tanks the removal is constant if attention to sludge removal be given. With septic tanks the removal is reduced about 50 per cent. after a few months' working.

4th.—With septic treatment, the sludge contains about 80 per cent. of moisture. With sedimentation tanks, about 90 per cent. of moisture.

5th.—Sedimentation liquor is practically odorless. Septic tank liquor is very offensive.

6th.—The cost of sedimentation tanks in the first instance is about 25 per cent. less than septic tanks as they are not required to be so large.

7th.—The cost of maintenance is less in the case of septic tanks than in that of sedimentation tanks, as in the former, the sludge is only removed at long periods, while in the latter, at least once a month.

8th.—Sedimentation liquor is more easily and economically purified by filtration, either in land or by means of biological filters than septic liquor.

From the above it will be seen that there are many considerations to be taken into account before deciding as to whether it is worth while paying any royalty claim in the septic process.

All of the above of which is respectfully subscribed to by:—

A. F. Macallum, City Engineer for Hamilton.

T. Aird Murray, Consulting Sanitary Engineer, Toronto, Adviser to the Provincial Board of Health, Saskatchewan.

O. W. Smith, Consulting Engineer of Messrs. Galt & Smith, Toronto.

A. L. McAlister, associated with Messrs. Macallum & Murray.

Dr. Hodgetts announced that the above statement had been submitted to him and that he considered it a fair and accurate résumé of the present engineering position of the septic tank process.

A general discussion followed, and it was felt that the whole question was assuming great importance, and further that there should be a wider representation of municipalities interested in the question. Up to the present only such towns have been invited who have had notice served upon them by the Septic Company, and the town of Berlin was a notable absentee from the proceedings. Berlin is having a meeting of its own, due to some unfortunate misunderstanding with the secretary as to the nature of the meeting.

Dr. Hodgetts having explained that this question of septic royalties was one which not only affects the towns where such plants are installed, but also such towns such as Cobalt and Palmerston, and others who are anticipating such schemes, as well as all the private septic tanks in Canada.

It was resolved to adjourn the meeting to an early future date, and in the meantime that the secretary, Mr. Willis Chipman, Consulting Engineer, 103 Bay Street, Toronto, notify all parties directly or indirectly interested in the matter. The date of the next meeting will be duly announced in the Review.

GRADE SEPARATION.

F. L. Somerville.*

Great interest is now being taken in Canada in grade separation. Many of the cities in the United States have had to take the question up and their solution of the problem may be of some interest.

Instead of grouping the works by methods of separation I have taken a few typical cases stated briefly how they dealt with the question, and given references so that fuller information may be secured if desired.

Allegheny, Pa. Population, 1900, 129, 896.

Railroad Gazette, Vol. 34, p. 374.

The work in Allegheny was made necessary by the elevation of the Pennsylvania System tracks in Pittsburg, which involved the construction of a new double deck bridge over the Allegheny River, which separates the two towns.

The article is mainly a description of the new bridge, but it says that in Allegheny from Anderson Street westerly the railway passes over Anderson, Sandusky and Federal Streets, from Federal Street the grade is descending westerly, and at Marion Avenue the new elevation is seven feet above the old grade, one half of the street will be depressed, making a subway under the tracks. The level of the track at Ridge Avenue will be unchanged, but beyond that point the track will be lowered (the maximum depression being about 16 feet) at North Avenue and Pennsylvania Avenue. These streets will be raised to go over the railway as will also be done at Washington Street, where the railway will be depressed about 3.5 feet, and the street raised about 16.5 feet.

This is necessitated by the railway passing over rising ground at this point, and the improvement of the grade called for depression at this point.

Boston. Population, 1900, 560,892.

Abolition of Grade Crossings on the Providence Division of the Old Colony Railroad in Boston, by J. W. Rollins, Jr. Journal Association of Engineering Societies, Vol. 14, p. 447.

The work will require the elevation of the tracks of the railroad beginning at Massachusetts Avenue, thence rising on a 0.6 per cent. grade to 18 feet above the existing tracks at Roxbury Station, thence the elevation is maintained at from 18 feet to 20 feet above existing grade to Washington Street, Forest Hill, where grade beigns to descend to meet old grade 3,000 feet further south.

This involves a change of 4½ miles of road over which on three tracks is (1894) handled a daily train service of 186 regular trains, and besides numerous extras, and will necessitate 15 road subways five-foot subways and one overhead bridge. Generally the construction is earth filling between retaining walls.

Separation of Grades of N.Y., N.H. & H. Railway in Boston, Railroad Gazette, Voy. 27, p. 383.

The New Haven road runs through a thickly populated suburban district with large numbers of crossings at grade, and to facilitate traffic and prevent crossing accidents the railway company has decided to elevate its tracks.

*Consulting Engineer, Toronto, Ont.

The general plan is to raise the tracks about 20 feet above old grade, on fill between retaining wall or with turfed slopes where there is room. Street crossings made by steel or iron arch bridges, or stone arches. All floors solid, elevated structure to carry four tracks.

Total cost, $3,500,000, of which railway pays 55 per cent., length 4½ miles.

This is a clear case of railway elevation with down grades at each end to connect with present grades.

Readville, Dedham and W. Roxbury Improvement, Railroad Gazette, Vol. 30, p. 574.

Length, about 7 miles.

All grade crossings abolished.

Cost divided as follows:—55 per cent. to the railways; 18 per cent. to the State; 13½ per cent. each to towns of Hyde Park and Dedham.

Readville is a small village, and tracks were raised and roads altered to suit convenience of railway.

Boston and Providence Extension.

Railroad Gazette, Vol. 31, p. 838, 856.

Partly depressed and partly elevated. A large portion of this line is on artificial ground. The Boston and Albany (Boston and Worcester) line built in 1833 was for a long distance surrounded by the water of the bay on both sides and the surrounding submerged flats have been gradually filled in as the city grew. The ground being of this nature the foundations of all retaining walls, bridges, piers, and reconstructed buildings had to be made on piles.

Buffalo, N.Y. Population, 1890, 255,664; 1900, 352,587.

Railroad Gazette, Vol. 24, p. 328; Journal Association of Engineering Societies, Vol. 10, p. 422.

There were more than 330 grade crossings in the city each having from 1 to 4 tracks, and one having 13 tracks.

In 1887, Thos. Spencer, Engineer to State Commission, recommended certain work whereby the tracks were to be elevated at interior points and depressed elsewhere, but as this plan was not sufficiently comprehensive, the question was next taken up by a commission of engineers composed of Col. H. Flad, State Engineer Jno. Bogart, G. W. McNulty, A. M. Wellington, Geo. E. Mann, Walker Katti and C. W. Buckholz.

This commission reported in 1888 dealing with 37 crossings, and recommended overhead bridges, elevation of tracks within some cases depression of roadways and the closing of some crossings and diversion of traffic to other crossings. Grades of approaches not to exceed 4 per cent. Minimum clearance for overhead bridges 16 feet and for subways 12 feet.

In 1892 a report was made by E. L. Corthell, of Chicago, and A. W. Locke, recommending the abolition of 76 grade crossings mostly by lowering the streets and raising the tracks.

It is recommended that the streets be maintained at their full width, and the railroads provided with means of passing at full speed to and from their stations, that but few streets be closed, and that the present ruling grades for streets in the various sections of the city should not be increased and that 3 per cent. be the maximum grade.

The report also says, "When sidings are not too numerous it will sometimes be found to be cheapest to raise or lower the tracks rather than to confine the change altogether to the streets. In cities the latter plan is apt to entail large expense for damages done to adjoining states, while as a general thing, damages for changes in the grade of the railroad cannot be recovered by adjoining owners.

Brockton, Mass. Population, 1900, 40,063.

From Journal Association of Engineering Societies, Vol. 14, p. 420.

Population, 30,000. Area, 20 square miles. Date of report, September 21st, 1892.

Town is rectangular in shape approaching a square through the centre of which runs the Old Colony Road.

Within the city limits are three stations with freight yards and houses:—Montello, Brockto and Campbells, as in most manufacturing towns, the growth has been along the line of the railway; gradually streets have been laid out across the tracks, all at grade, and public ways, so that at the present time there are eleven crossings at grade over which the public have rights. The freight yard at Brockton is at present in the centre of the city, and over which freight cars have to be shifted across the principal streets.

When the grade crossing law was passed in 1890, Brockton was the first city to take advantage of it. After long discussion an agreement was reached in June, 1893, to raise the grade of railway through the centre of the city 12 feet, and to depress through Campbells about 8 feet. The plans as finally adopted were:—

The grade of the railways to be raised for 9,000 feet with a maximum rise of 15 feet, and to be lowered for 5,100 feet with a maximum lowering of 12 feet. All stations to be double with a main station on the west side of the tracks, and a waiting station on the east track with subways under the tracks connecting the two stations. The changes decided upon require 7 arches over streets, 2 arches over streams, 4 subways for pedestrians, 2 plate girders over streets, and 8 highway bridges over the railroad.

The main freight yard at Brockton covers about 40 acres, and will be 24 feet below grade of tracks as raised, and will be approached by switchback with about 800 feet of tail track with grades ranging from 1.2 per cent. to 0.4 per cent. All streets will have to be changed more or less to get under or over the tracks in many cases involving other streets, and necessitating changes in water and gas pipes.

The cost to be divided as follows:—Railway Company, 65 per cent.; State, 25 per cent.; city, 10 per cent.

Chicago.

The 40th Street Track Elevation of the Chicago Junction, Railroad Gazette, Vol. 44, p. 243.

The Chicago Junction is a switching road, the chief function of which is to handle the Union Stock Yard business.

The 40th Street line runs east to connection with the Illinois Central on the lake front and crosses the Lake Shore and Michigan Southern, the Chicago, Rock Island and Pacific, the Pittsburg, Ft. Wayne and Chicago, and the Chicago and Western Indiana, all of which secure connection to the Stock Yards through it. Built some 30 years ago it is now in a closely-built section of the city occupying the larger part of the thoroughfare from which it takes its name.

In doing the work of separation of grades, the Chicago Junction, under agreement with the South Side Elevated, built extra lines on 40th Street, which they will lease to the elevated road.

The elevation of the 40th Street line extends from the Lake Shore to Union Street two blocks from the Stock Yards, where it swings southward to enter the yard.

Commencing at the east end of the Illinois Central, where there are some team tracks the grade rises to Drexell Boulevard with two tracks as far as Wentworth Avenue; four tracks from Wentworth Avenue to Butler, and six tracks from Butler to Stock Yards.

The line generally is built with solid embankments between retaining walls, and has bridges with solid ballasted floors.

The line passes over the Lake Shore and the Rock Island tracks which are already elevated (the grades approaching the crossing being 1.3 per cent., and the clearance 18 feet), and passes under the P. F. W. & C., and the Western Indiana which have been elevated. There appear to be 25 subways for street crossings. From there it falls on a 1.3 per cent. grade to pass under the P. F. W. & C., and the Western Indiana which have been elevated.

Twenty-five streets appear to be crossed by these tracks a[illegible] in subways.

Chicago.

Engineering News, Vol. 43, p. 24, January 11th, 1900.

Progress of Track Elevation at Chicago.

An article on the above subject gives the following table:—

Track Elevation.	Length of track in miles.	Length of main tracks miles.	No. of cross-ings eliminated.	No. of subways built.
A. T. & F. Ry.	1.75	3.50	...	..
C. & Alton R. R.....	0.65	0.65	...	..
C. & N. W. Ry.	14.85	60.00	150	96
C. B. & Q. R. R.	2.75	11.00	14	16
C. M. & St. P. Ry. ...	8.40	18.30	33	29
C. R. I. & P. Ry., & L. S. & M. S. Ry. ..	5.50	22.00	32	32
C. R. I. & P. Ry. (alone)	1.80	3.60	15	14
L. S. & M. S. Ry. (alone)	0.90	1.80	2	3
Ill Cen. R. R.	3.00	30.00	19	26
C. M. & N. Ry.	1.00	2.00	..	..
S. C. Air Line	1.25	2.50	3	3
P. C. C. & S. L. R. (1,330 miles) included in C. & N. W. Ry.				
P. Ft. W. & C. Ry. ...	2.50	10.00	15	15
Total Elevation	44.00	165.35	283	234
Tracks Depressed:—				
A. T. & S. F. Ry. & C. & W. I. R. R. ...	0.50	10.00	2	2
C. M. & St. P. Ry. ...	0.50	0.50	.	.
Illinois Central Ry. ..	2.00	52.00	.	.
Total Depression	3.00	62.50	2	2
Work Provided for—				
A. T. & S. F. Ry. & C. M. & N. Ry.	2.84	12.30		
C. & Alton Ry.	4.50	13.50	56	40
P. C. C. & St. L. Ry., C. T. T. R. R. & W. St. Yds. & Co.	1.27	3.50		
P. Ft. W. & C. Ry., & W. L. R. R., Gd. T. R. & W. St. Yd. Co.	4.00	16.00	75	75
Total work provided for	12.61	45.23	131	115
Total work done and provided for	56.96	273.08	416	351

Nottingham. Population, 1901, 239,743.

Proceedings, Inst., C.E. Great Central Railway, England. Northern Division.

A viaduct carries the railway across part of the town and passes over a number of streets, a canal and the tracks of the Midland Railway. For the rest of the town the track is principally in tunnel or cutting with a few overhead bridges.

At Loughborough (population, 1901, 21,508), the track is elevated, and at Leicester (population, 1901, 211,579), it is carried on a viaduct. A right-of-way occupation road crosses the line at grade about a mile south of Leicester, this being a special case, and the only grade crossing on the 52 miles of line.

Generally, this railway runs at right angles to the run of the ridges and valleys which caused heavy work in deep cuts or tunnels and high fills or viaducts.

Jersey City, N.J. Population, 1900, 206,433.

Erie Track Elevation. Railroad Gazette, Vol. 29, page 74.

All grade crossings to be abolished which necessitates the elevation of the tracks from mouth of Bergen Hill Tunnel to the Terminal Yard at the water front. The crossing overhead of six streets and the closing of three streets.

The new grades will be much worse than the old ones, the main line between Henderson Street and the trainshed falling 0.832 per cent.; the elevated branch falling 1.75 per cent.; and the freight yard branch falling 2.49 per cent. to overcome which it will no doubt be necessary to elevate the yards between Henderson Street and the docks. The Engineering News (Vol. 57, page 204, February 21st, 1907), in describing the construction of a new four-track line through Bergen Hill, partly in open cut and partly in tunnel, says "the Erie looks forward to elevating its tracks, passing through the low lying portion of the city to the east of Bergen Hill."

Pennsylvania Railroad Terminal Improvement.

Engineering News, Vol. 24, page 572, December 27th, 1890.

The work comprises the construction of a four-track viaduct about 3,000 feet long, replacing oil surface tracks and grade crossings. This elevated structure runs from Bergen Hill to Henderson Street, and from there to the end of track the surface has been elevated by filling to height of 15 to 20 feet above the former surface. Heavy retaining walls support the embankment on all sides. Total area elevated covers about 55,000 square yards, requiring 350,000 cubic yards of filling.

Montreal, Que. Population, 267,730 in 1901.

Transaction of Canadian Society of Civil Engineers, (February 15th, 1900).

Ontario Street subway carries street under ten tracks of the C.P.R. at Hochelaga, width of subway 40 feet over all, with 3 feet wall and posts in the centre, leaving two roadways 13 feet and 6 inches, and two sidewalks 5 feet wide.

Brock Street tunnel built from Craig Street to wharf to eliminate the climb to and from Notre Dame Street passes under C.P.R. tracks.

Notre Dame Street viaduct carries the street over the tracks of the C.P.R. leading to Place Viger Station.

Milwaukee, Wis. Population, 1900, 285,316.

Engineering News, March 9th, 1905.

The problem of separation of grades is being taken up for the following reasons:—

1st.—Elimination of danger due to grade crossings.

2nd.—Elimination of delay to street traffic (including fire department equipment.)

A commencement has been already made, one piece of the line has been depressed, an ordinance has been passed and accepted, for the elevation of another line, and preliminary arrangements made in regard to other lines so that the work of eliminating the grade crossings will be spread over a number of years.

Track Depression.

The part already done is the depression of the main line of the C. & N. W. Railway where it passes through the north-east part of the city. This line has three tracks, but the width between retaining walls and abutments is made for four tracks. Part of the line has retaining walls on both sides, or on one side only, the remainder being through ordinary cuts with some side hill work along the Milwaukee River. The maximum depression is 18 to 20 feet, and the city lowered the sewers and water mains so as to place them about five feet below sub-grade.

Track Elevation.

The C. & N. W. Railway has accepted an ordinance providing for the elevation of the tracks of its Madison Division in the south-east part of the city, from the city limits to Greenfield Avenue. An ordinance is pending for the elevation of the C. M. & St. P. Railway tracks, which parallel those of the C. & N. W. Railway from Lincoln Avenue to Greenfield Avenue, including part of the spur connecting with the Chicago line of the latter railway. Negotiations are also in progress in regard to the lines of the C. M. & St. P. Railway running west from Union Station.

Work is held up as the Federal Government has decided to improve Kenneckennie River, and until the new harbor lines as established, the railways cannot definitely locate their bridges.

The ordinance covering the work of the C. & N. W. Railway in the south-east part of the city specifies that embankments may have side slopes or retaining walls and cross streets and alleys must be crossed with steel girder bridges supported on concrete or masonry abutments or upon rows of iron or steel columns braced together laterally and founded on masonry foundations built within the limits of the right-of-way and in the centre and curb lines of the streets. Solid floors or open floors may be used, but for the latter some means must be provided to prevent dirt dropping in the subway. The subways to have a clear headway of 12 to 13½ feet. Some streets will be lowered at the subways with a maximum grade of 4 per cent. and vertical curves at head of approaches. Paving of subways to be brick with cement sidewalks. Railway company to pay for all the above, except where street railways cross when paving must be paid for by the latter.

If additional subways are required in the future they are to be built by the railway and paid for by the city. The city pays no part of the expense but agrees to defend any suit brought against the city or railway for damages by adjacent property or business claimed to result from the execution of the work.

(To be Continued Next Week.)

RAILROAD ORDERS.

(Continued from Page 4.)

7283—June 18—Extending for a period of one year from the 31st of June, 1909, the time for the use of the crossing by the Victoria, Vancouver and Eastern Railway, at rail level, of its railway by the track of the British Columbia Electric Railway at Park Avenue, in the city of Vancouver.

7284—June 8—Authorizing the C.P.R. to construct a spur at Mile End, town of St. Louis, District of Montreal, Que., on the premises of Messrs. Hyde & Webster.

7285—June 8—Dismissing application of Joseph Ethier, Montreal, to amend Order of the Board, dated January 23rd, 1905, authorizing the G.T.R. to take certain lands, then the property of the city of Ste. Cunegonde, Que.

7286—June 18—Approving deviation, change, and alteration in main line of the C.P.R., near Steel Siding, District of Thunder Bay, Ont.

7287—June 18—Granting leave to the Vancouver and Lulu Island Railway to construct its Westminster and Eburne Branch across the Trapp Road at Station 425, and across the Byrne Road at Station 355, District of Burnaby, B.C

7288 to 7290—June 18—Granting leave to the Toronto Suburban Railway Co. to erect, place, and maintain its electric wires across the track of the C.P.R. and G.T.R, in the Township of York, County of York, Ont.

7291 to 7293—June 9—Granting leave to the corporation of the city of Edmonton, Alberta, to cross at level with its lines the lines of the G.T.P. and C.N. Railways at the intersection of the lines of said companies at Alberta Avenue, Edmonton; to erect, place, and maintain necessary poles and wires to transmit power across the G.T.P. and C.N. Railways at the intersection of the lines of the said companies at Alberta Avenue, Edmonton; and to cross the lines of the G.T.P. and C.N. Railways at the intersection of Syndicate Avenue at or near its intersection with Griesbach Street, Edmonton, Alta.

7294—June 17—Reporting to the Governor-in-Council for sanction by-law of the Bay of Quine Railway re spitting in cars or on railway premises.

7295—June 14—Approving additions and changes in proposed Supplement No. 1 to the Canadian Freight Classification No. 14, with one or two exceptions.

7296—June 19—Approving proposed station layout of the C.N.R. at Saskatoon, Sask.

7297—June 19—Directing the Grand Valley Electric Railway to fence certain portions of its line within sixty days from date of Order.

7298—June 19—Dismissing application of the C.P.R. for Order directing the G.T.R. to receive passenger and baggage cars of C.P.R. and deliver same to the C.P.R. at point of junction of tracks of the Ottawa, Northern and Western Railway with the tracks of the Canada Atlantic Railway, near Sapper's Bridge, Ottawa, Ont.

7299—June 16—Directing the Western Counties Electric Co. before July 1st, 1909, to erect, place, and maintain its wires across the railway and telegraph wires of the G.T.R. at the Elgin Street Subway, Brantford, Ont.

7300 and 7301—June 17—Granting leave to the Boggy Creek Rural Telephone Co., Limited, to erect, place, and maintain its wires across the track of the C.N.R. between Sections 1 and 2, Township 19, Range 21, west second meridian, Saskatchewan, and between Sections 23 and 26, Township 19, Range 21, west second meridian, Saskatchewan.

7302 and 7303—June 21—Granting leave to the Government of the Province of Alberta to erect, place, and maintain its wires across the track of the C.P.R. in the centre of Bow Island, and just west of Grassy Lake, Alta.

7304—June 19—Granting leave to the Bell Telephone Co. to erect, place, and maintain its wires across the P.M.R.R. at Talbot Street, St. Thomas, Ont.

7305—June 17—Granting leave to the municipality of the village of Streetsville, Ont., to erect, place, and maintain its electric light wires across the track of the C.P.R. at Tannery Street, Streetsville, Ont.

7306—June 18—Authorizing the G.T.R. to construct, maintain, and operate branch lines on certain streets in the town of Sarnia, Ont.

7307—June 18—Authorizing the C.P.R. to construct, maintain and operate spur in the town of Gonor, Man., to and into the premises of the Government of Manitoba.

7308—June 18—Granting leave to the Shawinigan Water and Power Co. to erect, place, and maintain its transmission wires across the track of the Q.M. and S.R., near St. Gregoire, Que.

7309—June 19—Authorizing the C.P.R. to construct, maintain, and operate branch line of railway at Kamloops, B.C.

7310—June 18—Authorizing the C.P.R. to construct Bridge No. 34 over the Yamaska River, Drummondville Section (Eastern Division), of its line of railway.

7311—June 21—Approving and sanctioning location of the C.N.R through the Townships of Himsworth and Nipissing, District of Parry Sound, Ont.

7312—June 21—Approving location and detail plans of the C.P.R. Co.'s standard No. 4 Station at Moffat, County of Wellington, Ont.

7313—June 21—Approving location of the C.P.R. Co.'s station at Mountain, Ont.

7314—June 21—Authorizing the G.T.R. to connect its main line track, on the east side of the Potowotamie River, Township of Grey, Ont., with sidings of the Owen Sound Portland Cement Co., Limited, Owen Sound, Ont.

7315—June 21—Approving change in location of the E. and N.R. Co.'s line from mileage 100 to 127, Alberni Branch.

7316—June 21—Granting leave to the London Township Telephone Co. to erect, place, and maintain its wires across the track of the London, Huron and Bruce Branch of the G.T.R. at public crossing on the Town Line between MacGillivray and Biddulph Townships, two miles north of Denfield Station, Ont.

7317—June 19—Rescinding Order No. 6520, dated March 15th, 1909, approving plans of the crossing of the track of the C.P.R. by the track of the London Street Railway Co. at Richmond Street, London, Ont.; and the C.P.R. is directed to serve forthwith upon the London Street Railway plans of the interlocker proposed to be installed at the said crossing.

CONSTRUCTION NEWS SECTION

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand and projected, contracts awarded, changes in staffs, etc. Printed forms for the purpose will be furnished upon application.

TENDERS.

Prince Edward Island.

CHARLOTTETOWN.—Tenders will be received up to Monday, July 12th, for the construction of a 20 stall, brick and concrete engine house, foundation for turntable, foreman's office and lavatories. Plans may be seen at the Resident Engineer's Office, Charlottetown, at the office of the Chief Engineer, Moncton, N.B.. M. J. Butler, Chairman, Ottawa, Ont.

New Brunswick.

SACKVILLE.—Tenders for the erection of a new ladies' college will be received up to July 7th, 1909. B. C. Borden.

PINK ROCK.—Tenders will be received until Monday, July 5th, for the construction of a Wharf Extension and Breakwater at Pink Rock. Plans can be seen at the offices of E. T. P. Shewen, St. John, N.B., and Geoffrey Stead, Chatham, N.B. Napoleon Tessier, Secretary Public Works Department, Ottawa, Ont.

Quebec.

ST. LOUIS.—Tenders will be received until July 2nd for concrete to be used as foundation for sidewalks. J. Emile Vanier, Town Engineer, 5 Beaver Hall Square, Montreal.

Ontario.

BRANTFORD.—The City Engineer, T. Harry Jones, will shortly ask for tenders for pavement work, sidewalks, curbs, and gutters.

NORTH BAY.—Tenders for Customs and Inland Revenue fittings will be received until Monday, July 12th, 1909. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

TORONTO.—Tenders will be received until July 12th, for the construction of concrete storage and regulating dams near Port Arthur. H. F. McNaughten, Secretary, Department of Public Works. (Advertized in the Canadian Engineer.)

MOOSE CREEK.—Tenders will be received until July 12th for excavations for a drain. Estimated cost, $5,000. F. D. Brunet, Township Clerk.

WELLAND.—Tenders will be received until July 5 for additions to schools. Ellis & Connery, architects, Toronto. J. McCaw, secretary, School Board.

CHAPLEAU.—Tenders will be received until July 5th for waterworks equipment. W. H. Farrell, Town Clerk. Willis Chipman, C.E., 103 Bay Street, Toronto. (Advertised in The Canadian Engineer.)

METAPEDIA.—Tenders will be received until Friday, July 9, for the construction of approaches to the highway bridge across the Restigouche River at Metapedia, Province of Quebec. Plans can be seen at the offices of E. T. P. Shewen, Resident Engineer, St. John, N.B.; C. E. W. Dodwell, Resident Engineer, Halifax, N.S.; J. L. Michaud, Resident Engineer, Merchants Bank Building, Montreal, Que., and at the office of the Chief Engineer of the Intercolonial Railway, Moncton, N.B. Napoleon Tessier, Secretary, Department of Public Works, Ottawa.

FORT WILLIAM.—Tenders will be received until July 5th for electric wiring and fittings in Post Office building. Address, W. T. Rankin, Fort William, or Napoleon Tessier, Secretary, Public Works Department, Ottawa, Ont.

TORONTO.—Tenders will be received until Monday, 5th July, for concrete foundation work in connection with the extensions to the Ontario Government Buildings. H. F. McNaughten, secretary, Department of Public Works. (Advertised in the Canadian Engineer.)

OTTAWA.—Tenders will be received until July 15th for the supply of coal for the Public Buildings throughout the Dominion. Napoleon Tessier, Secretary, Department of Public Works.

Manitoba.

WINNIPEG.—Tenders of brass and galvanized fittings for meter installation will be received up to Friday, July 2nd, M. Peterson, Secretary, Board of Control.

WINNIPEG.—Tenders will be received up to Saturday, July 3rd, for all the work involved in the grading of the spur line. The entire work involves:—Clearing, 5.1 acres; grubbing, 0.4 acre; close cutting, 0.8 acre; earth excavation, 3.073 cubic yards; rock excavation, 3,600 cubic yards; cedar culverts, 6,000 feet, B.M.; ties (half tamarac), 1,900 (6-in. x 6-in. x 8ft.). M. Peterson, Secretary, Board of Control.

WINNIPEG.—Tenders will be received until August 2nd and August 16th for hydraulic, electric, and auxiliary equipment for the generating station at Point du Bois. For plans, etc., apply Smith, Kerry & Chase, engineers, Toronto and Winnipeg; Wm. Kennedy, jr., Y.M.C.A. Building, Montreal, and M. Peterson, secretary, Board of Control, Winnipeg.

Saskatchewan.

REGINA.—Tenders will be received until July 19th, for a supply of sewer pipe. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

MOOSE JAW.—Tenders will be received up to Monday, 18th July:—1-50 light, constant current transformer or regulator, with 35 arc lamps and suitable switchboard, with necessary instruments for controlling same; one year's supply of Watt meters; one' year's supply of transformers. John D. Simpson, City Clerk.

REGINA.—Tenders will be received until July 19th, for concrete pavements, curbs, and sidewalks. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

REGINA.—Tenders will be received until July 19th, for a supply of pipes and valves for waterworks system. Angus Smith, City Engineer. (Advertized in the Canadian Engineer.)

NORTH BATTLEFORD.—The time for receiving tenders in connection with the proposed waterworks and electric lighting systems has been extended to July 9th. Willis Chipman, C.E., 103 Bay Street, Toronto.

British Columbia.

VICTORIA.—Tenders will be received up to Monday, 16 August, for the supplying of cast iron water pipe, pig lead, gate valves, for waterworks. W. W. Northcott, Purchasing Agent.

VICTORIA.—Tenders will be received up to Saturday, 10th July, for the cables and metal required in connection with a Suspension Bridge over the Fraser River, to be delivered at Lytton, B.C. F. C. Gamble, Public Works Engineer.

FERNIE.—Tenders will be received until July 2nd for the installation of water supply, including 14,000 feet of 12-inch wood stave pipe line and a concrete dam. Robert Potter, City Engineer.

FINANCING PUBLIC WORKS.

Quebec.

LACHINE.—The City Treasurer invited tenders for municipal bonds amounting to $115,000.

HULL.—A by-law to be submitted to the ratepayers shortly includes $22,000 for waterworks extensions and $30,000 for new pumps.

Ontario.

PICTON.—The County Treasurer of Prince Edward solicits tenders for $35,000 good roads debentures.

CHAPLEAU.—This municipality offers for sale $31,000 waterworks debentures. W. H. Farrell, clerk.

BERLIN.—The ratepayers have sanctioned a by-law to provide $19,000 for double tracking a portion of the line between Berlin and Waterloo.

AURORA.—Tenders are invited by this municipality for $4,800 debentures, including $1,200 for artesian wells. G. H. Lundy, clerk.

Manitoba.

WINNIPEG.—The ratepayers will shortly vote on a by-law of $400,000, for three bridges.

VIRDEN.—The municipality of Wallace asks for tenders for $20,000 telephone debentures.

CARMAN.—Sewer and waterworks debentures aggregating $25,000 are offered for sale by this municipality.

WINNIPEG.—A by-law for $400,000, for three bridges, and others, aggregating $600,000, were passed recently by the property owners of Winnipeg.

Saskatchewan.

REGINA.—J. Kelso Hunter, city clerk, invites tenders for debentures amounting to $313,600, including electric light, waterworks, sewerage and other local improvements.

Alberta.

MEDICINE HAT.—School debentures amounting to $50,000 are offered for sale by School District No. 76.

British Columbia.

FERNIE.—The by-laws to raise $15,000 for a new fire hall and $15,000 for parks have been passed.

MISCELLANEOUS.

Ontario.

TORONTO.—The University of Toronto has applied for a permit to erect the library building, the excavation work of which has been begun. The building will cost $175,000.

British Columbia.

VANCOUVER.—Frederick J. L. Tytler, M. Can. Soc. C.E., has outlined plans for a bridge to be erected across the first narrows at Prospect Point. The span, from tower to tower will be 1,250 feet.

Foreign.

BUFFALO, N.Y.—The report of the International Waterways Commission, which is almost ready, will recommend, it is said, the building of a dam across the Niagara River to raise the level of the Great Lakes.

CONTRACTS AWARDED.

Nova Scotia.

SYDNEY.—The following tenders were received for erecting the new fire hall: Rhodes, Curry & Co., $12,800; F. L. Dixon, $13,700, and Chappell Bros., $16,000. The lowest was accepted.

HALIFAX.—Stairs, Son & Morrow, Limited, have been awarded a contract for valves by the city council.

New Brunswick.

FREDERICTON.—The Hassam pavement contracts awarded recently to Mr. R. S. Low, of Sydney, by the city council, amount to $6,164.

Quebec.

MONTREAL.—Hyde and Webster have been given a contract for Metropolitan paving blocks at $45.50 a thousand by the Montreal council.

MONTREAL.—At a recent meeting of the Westmount City Council in connection with the extension of the electric plant, the following tenders were accepted: Canadian Westinghouse Company, switchboard, $1,285; John McDougall Caledonian Iron Works, cooling tower, $2,900; Darling Bros., feed water heater, $700; Canadian Crocker-Wheeler Company, generator and accessories, $4,650; Belliss & Morcom, Birmingham, England (Laurie & Lamb, agents), compound condensing engine, etc., $7,000.

Ontario.

TORONTO.—The Canada Foundry Company have been given a contract for 31,680 feet of 12-inch pipe for water mains, by the Board of Control.

LONDON.—The joint committee appointed by Middlesex and Lambton counties have awarded the contracts for the Thedford bridge over the Aux Sauble River. The tenders called for a steel superstructure and concrete flooring, and abutments. The span of the bridge is to be 140 feet. The contract for the steel work was awarded to the Stratford Bridge Company at $3,410, and for the concrete work to Lev. Crouse, of this city, at $1,380.

Manitoba.

WINNIPEG.—The contract for supplying and installing the electric lighting fixtures in the Fort Garry depot has just been let to the Robert Mitchell Company, Limited, of Montreal. It covers all chandeliers and lights, exclusive of the wiring, which is covered by a separate contract, and involves a sum in the neighborhood of $30,000.

Alberta.

CALGARY.—The City Council asked for tenders from local manufacturers for supplying a smoke stack for the power house, and received the following: Alberta Culvert Company, $350; Union Iron Works, $265; Calgary Iron Works, $240. The lowest was accepted.

British Columbia.

FERNIE.—The contract for the new court house, $70,000, went to James A. Broley, a local contractor.

VICTORIA.—Tenders for the paving of Wharf Street, the city to supply the brick, were opened at a recent meeting. The tenders were Luney Bros., $23,550; Cameron Co., $16,766.63; Steadham, Sabine & Stevens, $12,945.

RAILWAYS—STEAM AND ELECTRIC.

Nova Scotia.

PORT WADE.—Engineers are at Port Wade making a survey for the proposed increased facilities for the H. & S. W. Railway.

Quebec.

MONTREAL.—The Canadian Northern Railway's line from Montreal to Quebec will be formally opened July 15th.

Ontario.

OTTAWA.—The minister of railways has approved of the route map of the G.T.P. branch line from Regina to North Portal, and the C.N.R. branch from Maryfield to Lethbridge. The latter line is directed to pass through Carlyle, Sask., instead of through Manor.

SANDWICH.—The town of Sandwich recently complained of the service given by the Sandwich, Windsor and Amherstburg Railway, and the question of their right to use the streets was disputed. The original agreement between the parties was destroyed by fire some 30 years ago. According to the decision of the Ontario Railway and Municipal Board, the agreement expires on December 15th, 1912. The point will be decided by the Court of Appeal.

PORT ARTHUR.—The city council have decided to construct an extension of the street railway, and tenders will shortly be invited for material and labor. J. J. Antomiser is the city engineer.

Manitoba.

WINNIPEG.—The G.T.P. track will be laid into Edmonton by July 7. Gangs are now 48 miles from that city, but the strength will be doubled and they will now be able to lay four to six miles per day. The line will be 794 miles between this city and Edmonton.

WINNIPEG.—Mr. Merry, C.E., will probably secure the contract for the construction of the first section of the North Battleford-Athabasca Railway, to be built by the Canadian Northern Railway. He is concentrating his outfit and supplies at North Battleford, preparatory to an early start.

WINNIPEG.—The work of laying the 80-pound steel between Port Arthur and Winnipeg on the Canadian Northern

line will be under way within the course of a week's time. The first of the new steel for the line arrived in Port Arthur recently. A large number of men have been working, and a number of work trains have been on the work of preparing the track.

Saskatchewan.

CARLYLE.—The construction of the Merryfield-Lethbridge branch of the C.N.R. began on 25th June.

MELVILLE.—Several hundred men are now at work on the Melville-Regina line, which is being built by McMillan Bros. & Kenny, and the Melville-Yorkton, which Rigley & Hyland will construct. By the end of the week 1,000 men will be at work.

Alberta.

EDMONTON.—The contract for the construction of two hundred miles of the G.T.P. between the McLeod River and the mountains has been let to Foley, Welsh & Stewart, and the work is to begin shortly.

British Columbia.

FERNIE.—A large party of railway surveyors is being outfitted to take the field next week for the purpose of surveying the line of the Canadian Western Railway, which is to run from Calgary to the international boundary.

CEMENT—CONCRETE.

Prince Edward Island.

CHARLOTTETOWN.—Tenders are invited for the construction of a 20-stall engine in which concrete will be used. Address, the Resident Engineer, P.E.I., Railway.

Quebec.

ST. LOUIS.—This municipality wants tenders for a concrete foundation for asphalt sidewalks. J. Emile Vanier, Town Engineer, 5 Beaver Hall Square, Montreal.

Ontario.

LONDON.—Lev. Crouse, of London, has secured a contract for the concrete abutments and flooring, at $1,380, for a bridge to be erected over the Aux Sable River.

TORONTO.—Elsewhere in this issue appears an invitation for tenders for the construction of concrete dams, near Port Arthur. The work will be done by the Department of Public Works of Ontario.

Saskatchewan.

REGINA.—This municipality has decided to construct 5,000 square feet cement sidewalk, 1,000 lin. feet curb and gutter and 1,225 square yards pavement, for which tenders will be received until July 19th. Angus Smith, City Engineer.

British Columbia.

FERNIE.—Tenders are wanted for the construction of a concrete dam in connection with waterworks here. R. Potter, City Engineer.

SEWERAGE AND WATERWORKS.

Quebec.

MONTREAL.—The John McDougall Caledonian Iron Works have just completed the installation of a Worthington pump, which will discharge thirteen million gallons into the city water mains every twenty-four hours.

British Columbia.

NEW WESTMINSTER.—Plans for a new 24-inch main from Coquitlam Lake to this city were outlined at a council meeting, on June 17, by Mr. H. M. Burwell, of Hermon & Burwell, consulting engineers. Mr. Burwell will make a preliminary survey and prepare an estimate of the cost of a new main for approval at the next meeting.

VICTORIA.—W. W. Northcott, purchasing agent, invites tenders for cast iron pipe, pig lead and gate valves, in connection with waterworks extensions.

Alberta.

WETASKIWIN.—The first sod was turned on June 12th in connection with the waterworks system which is being installed here by Galt & Smith, consulting engineers, of Toronto. Mr. E. L. Miles is engineer-in-charge.

LIGHT, HEAT, AND POWER

Ontario.

ST. THOMAS.—D. W. Yates Hydro-Electric Commission's engineer, submitted to the City Council the estimates of the cost of constructing a plant for the distribution of Niagara power. For an entire new plant for all purposes his figures were $83,620, with alternate propositions, which would mean the remodelling of the present plant for $82,810. The Council decided to accept the former proposition, and will ask the ratepayers to sanction the expenditure.

CURRENT NEWS.

Ontario.

OTTAWA.—Dr. W. F. King, Canadian Boundary Survey Commissioner, has received a telegram from British Columbia telling of the death of a young man named Sheppard, a member of a survey party now re-marking the Alaska boundary. Sheppard, who lived in Nanaimo, was caught in an avalanche and carried down to the valley, 2,000 feet below. The body has not yet been recovered.

BRANTFORD.—City Engineer Jones visited Hamilton, Ont., recently and inspected various kinds of pavement and material.

TELEPHONY.

Saskatchewan.

MELVILLE.—The Provincial Government will install a local telephone system at once, with connection with the long distance telephone system.

Manitoba.

NEEPAWA.—A construction gang is here building lines and installing telephones contracted for some time ago.

PERSONAL.

MR. COLLINGWOOD SCHREIBER, chief consulting engineer of the G.T.P. will leave for the West in a few days on an inspection trip over the G.T.P. to Prince Rupert.

MR. LEWIS M. HAUPT, C.E., of Cleveland, Ohio, when in Toronto this week called at the Canadian Engineer's offices.

MR. T. L. DATES of the Sun Portland Cement Company, of Owen Sound, has just returned home from a successful business trip through the West.

MR. T. AIRD MURRAY, Consulting Engineer, of Toronto, has gone West to make his first report on various sanitary schemes submitted to the Provincial Board of Health of Saskatchewan.

MR. RODERICK J. PARKE, A.M., Amer. Inst. E.E., A.M. Can. Soc. C.E., Canadian manager of the British Aluminum Company, Ltd., Bank Toronto Building, Toronto, has returned from a three months' trip to Europe.

MR. HUGH LUMSDEN, chief engineer of the National Transcontinental Railway Commission, has resigned. Mr. Lumsden has been chief engineer of the Commission since its organization five years ago, and his resignation will be a great loss.

The tonnage of ore mined in 1908 in British Columbia was the largest ever produced by the Province, and the average assay of the ore also slightly greater than that of 1907, but the average market value of the various metals for the year was much lower, which accounts entirely for the decreased value of this year's output; since the drop in the market price of metals amounts to some $3,966,826.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, Geo. A. Mountain; Secretary, Prof. C. H. McLeod.

QUEBEC BRANCH—
Chairman, L. A. Vallee; Secretary, Hugh O'Donnell, P.O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, J. G. G. Kerry; Secretary, E. A. James, 62 Church Street, Toronto.

MANITOBA BRANCH—
Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 40-41 Flack Block, Vancouver. Meets in Engineering Department, University College.

OTTAWA BRANCH—
Chairman, C. R. Coutlee, Box 560, Ottawa; S. J. Chapleau, Box 203.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, R. Percy Barnes, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS (TORONTO BRANCH).—W. H. Eisenbeis, Secretary, 1207 Traders Bank Building.

AMERICAN MINING CONGRESS.—President, J. H. Richards; Secretary, James F. Callbreath, Jr., Denver, Colorado.

AMERICAN RAILWAY BRIDGE AND BUILDING ASSOCIATION.—President, John P. Canty, Boston & Maine Railway, Fitchburg, Mass; Secretary, T. F. Patterson, Boston & Maine Railway, Concord, N.H.

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, Wm. McNab, Principal Assistant Engineer, G.T.R., Montreal, Que.; Secretary, E. H. Fritch, 962-3 Monadnock Block, Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—Secretary, C. W. Hunt, 220 West 57th Street, New York, N.Y. First and third Wednesday, except July and August, at New York.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, Jesse M. Smith; Secretary, Calvin W. Rice.

ARCHITECTURAL INSTITUTE OF CANADA.—President, A. F. Dunlop, R.C.A., Montreal, Que.; Secretary, Alcide Chaussé, P.O. Box 259, Montreal, Que.

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

CANADIAN CEMENT AND CONCRETE ASSOCIATION.—President, Peter Gillespie, Toronto, Ont.; Vice-President, Gustave Kahn, Toronto; Secretary-Treasurer, Alfred E. Uren, 62 Church Street, Toronto.

CANADIAN ELECTRICAL ASSOCIATION.—President, N. W. Ryerson, Niagara Falls; Secretary, T. S. Young, Canadian Electrical News, Toronto.

CANADIAN INDEPENDENT TELEPHONE ASSOCIATION.—President, J. F. Demers, M.D., Levis, Que.; Secretary, F. Page Wilson, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, W. G. Miller, Toronto; Secretary, H. Mortimer-Lamb, Montreal.

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

CANADIAN STREET RAILWAY ASSOCIATION.—President, D. McDonald, Manager, Montreal Street Railway; Secretary, Acton Burrows, 157 Bay Street, Toronto.

CANADIAN SOCIETY OF FOREST-ENGINEERS.—President, Dr. Fernow, Toronto; Secretary, F. W. H. Jacombe, Ottawa.

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

DOMINION FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, R. H. Campbell, Ottawa.

DOMINION LAND SURVEYORS.—Ottawa, Ont. Secretary, T. Nash.

EDMONTON ENGINEERING SOCIETY.—President, Dr. Martin Murphy; Secretary, B. F. Mitchell, City Engineer's Office, Edmonton, Alta.

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

INTERNAL COMBUSTION ENGINEERS' ASSOCIATION.—Homer R. Linn, President; Walter A. Sittig, Secretary, 61 Ward Street, Chicago, Ill.

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

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, J. H. Winfield; Secrttary, S. Fenn, Bedford Row, Halifax, N.S.

ONTARIO PROVINCIAL GOOD ROADS ASSOCIATION.—President, W. H. Pugsley, Richmond Hill, Ont.; secretary, J. E. Farewell, Whitby, Ont.

ONTARIO LAND SURVEYORS' ASSOCIATION.—President, Louis Bolton; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

WESTERN CANADA RAILWAY CLUB.—President, Grant Hall; Secretary, W. H. Rosevear, 199 Chestnut Street, Winnipeg, Man. Second Monday, except June, July and August, at Winnipeg.

WESTERN SOCIETY OF ENGINEERS.—1735 Monadnock Block, Chicago, Ill. Andrew Allen, President; J. H. Warder, Secretary.

COMING MEETINGS.

Nova Scotia Society of Engineers: September 9 and 10. Third annual meeting at New Glasgow, N.S. S. Fenn, Halifax, N.S., secretary.

American Society of Civil Engineers.—Annual convention, Mount, Washington Hotel, Bretton Woods, N.H., July 6 to 9. Secretary, Chas. W. Hunt, 220 West 57th Street, New York.

American Railway Bridge and Building Association.—October 19-21. Nineteenth annual convention at Jacksonville, Florida. Secretary, S. F. Patterson, Boston & Maine Railway, Concord, N.H.

National Irrigation Congress.—Seventeenth meeting, August 9-14, at Spokane, Washington; Arthur Hooker, Secretary, Board of Control, Spokane, Wash.

League of American Municipalities.—August 25-27. Thirteenth annual convention at Montreal, Que. John MacVicar, Secretary, Des Moines, Iowa.

American Society of Municipal Improvements.—November 9-11. Annual convention at Little Rock, Ark., U.S.A. A. Prescott Folwell, Secretary, 241 W. 39th St., New York City.

Royal Architectural Institute of Canada.—October 5-7, at Toronto, general annual assembly. Secretary, Alcide Chaussé, R.S.A.; P.O. Box 259, Montreal, Que.

(Continued from Page 4.)

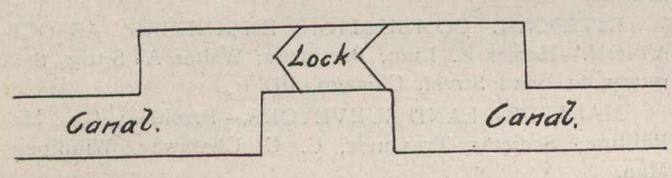
Section 42 specifies a shop coat of approved paint. It may be hopeless to try to get the engineering profession to agree on an approved paint, but probably red lead would more nearly satisfy the ideas of most members than any other kind.

The specification has covered only the work of the designer and manufactured of tanks, but, inasmuch as most contracts for tanks and stand-pipes, especially for municipalities, include their erection, it would seem desirable to give specification for erection, testing, and field painting.

It is to be regretted that the author did not see fit to give some text with the specifications.

SUGGESTIONS FOR CANAL LOCK.

Sir,—In re the question of preventing damage to lock gates, it appears to me that in the case at least of large and important canals, the locks might be located off the centre line as shown on the sketch. This would oblige boats approaching the lock to come to a dead stop and be towed



broadside into position. The extra expense of construction and loss of time in manipulation would probably not be so great as would at first sight appear. The idea must have occurred to many people, and I would be glad to have the opinion of those who are more conversant with the matter than I can claim to be. Yours truly,

Alexander G. Craig.

Peterborough, June 19th, 1909.

A NOTABLE MUNICIPAL REPORT.

A municipal report of more than ordinary interest is about to be issued by the city of Boston in the shape of a volume of over 1,200 pages, comprising nearly sixty individual reports made by Metcalf & Eddy, consulting civil engineers, of Boston, to the Finance Commission which recently completed its labors. In the course of this investigation the engineers studied deeply into the conditions of certain departments, particularly those of water and sewers, and made practical and far-reaching recommendations. Much detailed information of value is given regarding costs of construction and maintenance, the relative merits of contract and day work are sanely discussed, and the effect of age and term of service upon the efficiency of day labor is shown by numerous tables. Although relating principally to conditions in the city of Boston, the report also presents for comparison tabulated facts regarding different cities throughout the country. This volume possesses unusual interest for municipal officials and engineers, for it reports the work of experienced experts in a way to at least suggest the applicability of the results and conclusions to other municipalities. Unfortunately, however, the edition authorized by the city is so limited that practically no copies will be available for general distribution.

Canadian Society of Civil Engineers' Annual Excursion will be reported next week.

MARKET CONDITIONS.

Winnipeg, June 29th, 1909.

The country trade, taking the local market as a basis, is good, and the dealers report orders coming in for shelf and heavy hardware in a very satisfactory manner. This activity is accounted for by the large amount of building going on throughout the West. Fair orders are being obtained for wire nails and all lines of building paper, while the many items of builders specialties are active. Business has, if anything, strengthened up in the past week, as crop prospects are said to be the brightest in years, and money is in many cases looking for investment. Nothing definite, of course, is yet known as to the harvest, and country dealers will not place extensive orders until this is assured.

Local market quotations are as follows:—

Anvils.—Per pound, 10 to 12½c.; Buckworth anvils, 80 lbs., and up, 10¼c.; anvil and vice combined, each, $5.50.

Bar Iron.—$2.50 to $2.60.

Beams and Channels.—$3 to $3.10 per 100 up to 15-inch.

Building Paper.—4½ to 7c. per pound. No. 1 tarred, 84c. per roll; plain, 60c.; No. 2 tarred, 62½c.; plain, 56c.

Bricks.—$11, $12, $13, per M, three grades.

Coal and Coke.—Anthracite, egg, stove or chestnut coal, $9.75 large lots, to $10.50 ton lots, net; Alleghany soft coal; carload lots, basis, Winnipeg, f.o.b., cars, $6 per ton; cannel coal, $10.50 per ton; Galt coal, $8 f.o.b., carload lots, $9 single ton; coke, single ton, $7 at yard; large lots, special rates. American coke, $11 to $11.50 a ton; Crow's Nest, $10 a ton.

Cement.—$2.25 to $2.50 per barrel, in cotton bags.

Chain.—Coil, proof, ¼-inch, $7; 5-16-inch, $5.50; ⅜-inch, $4.90; 7-16-inch, $4.75; ½-inch, $4.40; ⅝-inch, $4.20; ¾-inch, $4.05; logging chain, 5-16-inch, $6.50; ⅜-inch, $6; ¼-inch, $8.50; jack iron, single, per dozen yards 15c. to 75c.; double, 25c. to $1; trace-chains, per dozen, $5.25 to $6.

Dynamite.—$11 to $13 per case.

Hair.—Plaster's, 80 to 90 cents per bale.

Hinges.—Heavy T and strap, per 100 lbs., $6 to $7.50; light, do., 65 per cent.; screw hook and hinge, 6 to 10 inches, 5¼c. per lb.; 12 inches up, per lb., 4¼c.

Iron.—Swedish iron, 100 lbs., $4.75 base; sheet, black, 14 to 22 gauge, $3.75; 24-gauge, $3.90; 26-gauge, $4; 28-gauge, $4.10. Galvanized—American, 18 to 20-gauge, $4.40; 22 to 24-gauge, $4.65; 26-gauge, $4.65; 28-gauge, $4.90; 30-gauge, $5.15 per 100 lbs. Queen's Head, 22 to 24-gauge, $4.65; 26-gauge English, or 30-gauge American, $4.90; 30-gauge American, $5.15; Fleur de Lis, 22 to 24-gauge, $4.50; 28-gauge American, $4.75; 30-gauge American, $5.

Lead Wool.—$10.50 per hundred, $200 per ton, f.o.b., Toronto.

Pipe.—Iron, black, per 100 feet, ¼-inch, $2.50; ⅜-inch, $2.80; ½-inch, $3.40; ¾-inch, $4.60; 1-inch, $6.60; 1¼-inch, $9; 1½-inch, $10.75; 2-inch, $14.40; galvanized, ½-inch, $4.25; ¾-inch, $5.75; 1-inch, $8.35; 1¼-inch, $11.35; 1½-inch, $13.60; 2-inch, $18.10. Lead, 6½c. per lb.

Picks.—Clay, $5 dozen; pick mattocks, $6 per dozen; clevishes, 7c. per lb.

Pitch.—Pine, $6.50 per barrel; in less than barrel lots, 4c. per lb.; roofing pitch, $1 per cwt.

Plaster.—Per barrel, $3.

Roofing Paper.—60 to 67½c. per roll.

Lumber.—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—

Nails.—$4 to $4.25 per 100. Wire base, $2.85; cut base, $2.90.

Tool Steel.—8½ to 15c. per pound.

Timber.—Rough, 8 x 2 to 14 x 16 up to 32 feet, $34; 6 x 20, 8 x 20, up to 32 feet, $38; dressed, $37.50 to $48.25.

Boards.—Common pine, 8-inch to 12-inch wide, $38 to $45; siding, No. 2 white pine, 6-inch, $55; cull red or white pine or spruce, 6-inch, $24.50; No. 1 clear cedar, 6-inch, 8 to 16 ft., $60; Nos. 1 and 2 British Columbia spruce, 6-inch, $55; No. 3, $45.

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Toronto, July 1st, 1909.

The holiday coming in the middle of the week has had the effect of making the market very quiet. Brick are in steady demand, but it is expected the yards will be able to supply the demand within a week. Cement remains firm, the demand from Western Canada helping to steady the market.

The following are wholesale prices for Toronto, where not otherwise explained, although for broken quantities higher prices are quoted:—

Antimony.—Demand inactive, market weak at $9 per 100 lbs.

Axes.—Standard makes, double bitted, $8 to $10; single bitted, per dozen, $7 to $9.

Bar Iron.—$1.95 to $2, base, per 100 lbs., from stock to wholesale dealer. Market well supplied.

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. The spring rush is over and business steady.

Bricks.—Business is very active, price at some yards $9 to $9.50, at others, $9.50 to $10, for common. Don Valley pressed brick move also freely. Red and buff pressed are worth, delivered, $18; at works, $17 per 1,000.

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 70c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Broken granite is selling at $3 per ton for good Oshawa.

Cement.—The supply is far beyond the demand, and every maker seems to have his storage capacity occupied to the full. There is no reason, therefore, to look for any immediate change in the present quotation of $1.70 per barrel, including bags, or $1.30 without bags, car lots; for smaller quantities $1.40 to $1.50 per barrel in load lots delivered in town and bags extra. In paper packages, price would be, including paper bags, $1.40 to $1.50.

Coal.—Pennsylvania hard coal the retail price in Toronto is $6.50, with a strong likelihood of its continuing at this price for a month or two, the operators appearing to have agreed for a while. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.50. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

Copper Ingot.—The firmness continues at $13.85 to $14.05 per 100 lbs. The demand continues moderate.

Detonator Caps.—75c. to $1 per 100; case lots, 75c. per 100; broken quantities, $1.

Dynamite, per pound, 21 to 25c., as to quantity.

Roofing Felt.—Unseasonably quiet, price maintained at $1.80 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $27.50 to $35 per 1,000. The demand is steady and stocks light.

Fuses.—Electric Blasting.—Double strength 4 feet, $4.50; 6 feet, $5; 8 feet, $5.50; 10 feet, $6. Single strength, 4 feet, $3.50; 6 feet, $4; 8 feet, $4.50; 10 feet, $5, per 100 count. Bennett's double tape fuse, $6 per 1,000 feet.