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Contents of this issue on page 861

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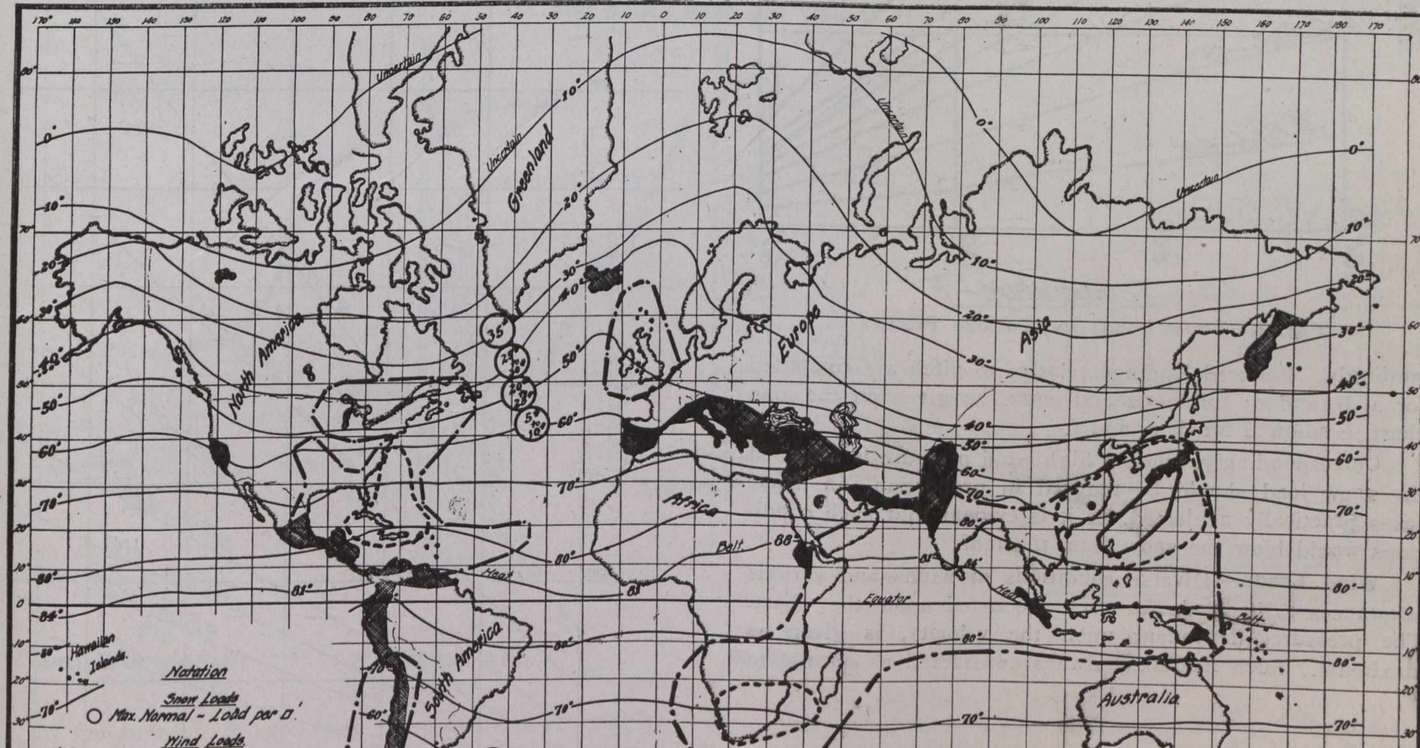
LOADING ASSUMPTIONS FOR STRUCTURAL DESIGN

By L. R. W. ALLISON.

Regional conditions of an extended period of time afford a basis for record which is vitally essential in computing loading assumptions for proposed structures. Variations in a specific locality covering many years would render a seasonable curve, if accurately plotted, comparatively uniform for the cycle average. Proper loadings for intelligent composition permits of ready service. Additional loadings other than those dependent upon the elements are neglected, being, of course, features of construction that rest almost entirely upon the type of design and the particular purpose.



and comprehensive structural design, contingent with the elements, have been established for terms of latitude by practice.

Such assumptions plotted upon regional lines are shown in the accompanying chart of the world. This offers in concise form, sufficiently accurate for all practical purposes, the fundamental considerations in design execution, especially for export work. The utility of the chart is evidenced for any section of the habitable world, and the method of

Snow Loads.—On the plotted temperature lines the normal horizontal snow load is given. This is maximum, and any reduction being proportional to the slope, the following formula is applicable:

Sn = normal snow load, pounds per sq. ft.

P = snow load for horizontal surface, pounds per sq. ft. (Obtained from chart).

a = angle of roof inclination with horizontal.

$$Sn = P\ (1 - \text{Sin. } a). \qquad (1)$$

The curves obtained in Fig. 1, considering mean temperature from 30 to 60 degrees Fahrenheit, have been computed by this formula. This gives correct snow load assumptions for customary roof slopes from the horizontal to 60 degrees, or nearly 1 pitch, which is in excess of usual conditions. Any intermediate inclination is readily figured from the formula (1).

Adjoining structures with roofs connected in series, as shown diagrammatically in Fig. 2, must be considered ac-

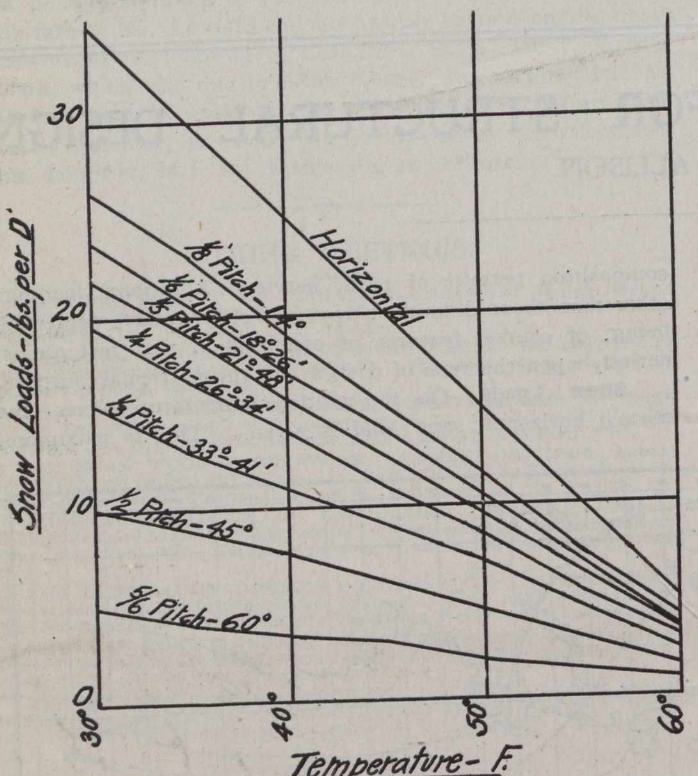


Fig. 1.—Snow Loads for Various Pitches.

cordingly. Reduced loadings relative to pitch are computed for a, b, and c; full horizontal snow, as given on the map chart, is allowed for d, e, and f.

Correspondingly, when a high wind pressure is assumed the snow load should be reduced in proportion, in some cases practically neglected, as it is evident that such conditions would blow the snow from the roof.

Wind Loads.—Diverse conditions of winds and various allowances to be made for such are noted upon the chart. The pressure, dependent upon the velocity, is given as maximum. Such loadings, always considered as normal to

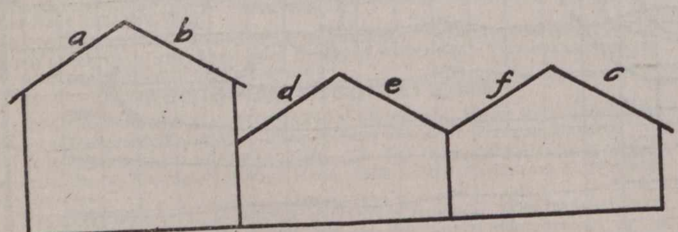


Fig. 2.

the slope, are capable of reduction for customary roof pitches by using the following formula, and from which the curve (Fig. 3) is derived:

Wn = normal wind pressure, pounds per sq. ft.

Pl = maximum wind pressure on vertical surface, pounds per sq. ft. (Obtained from chart).

a = as in formula (1).

$$Wn = Pl\left(\frac{2a + 5}{100}\right) \qquad (2)$$

For the various wind pressures given the formula (2) closely approximates the following:

For 20 lbs. $Wn = \frac{4}{9}a$

For 30 lbs. $Wn = \frac{2}{3}a$

For 50 lbs. $Wn = \frac{9}{8}a$

For 75 lbs. $Wn = \frac{5}{3}a$

These results are for "a" of 45 degrees or less; above this inclination the resulting normal and horizontal pressures are equal. The pressures given are in accord with modern practice, and for the United States and vicinity agree with tests made by the Signal Service Bureau.

Earthquake Regions.—The chart is serviceable in locating districts of seismal disturbances. As design in such localities embodies a thorough study of prevailing conditions,

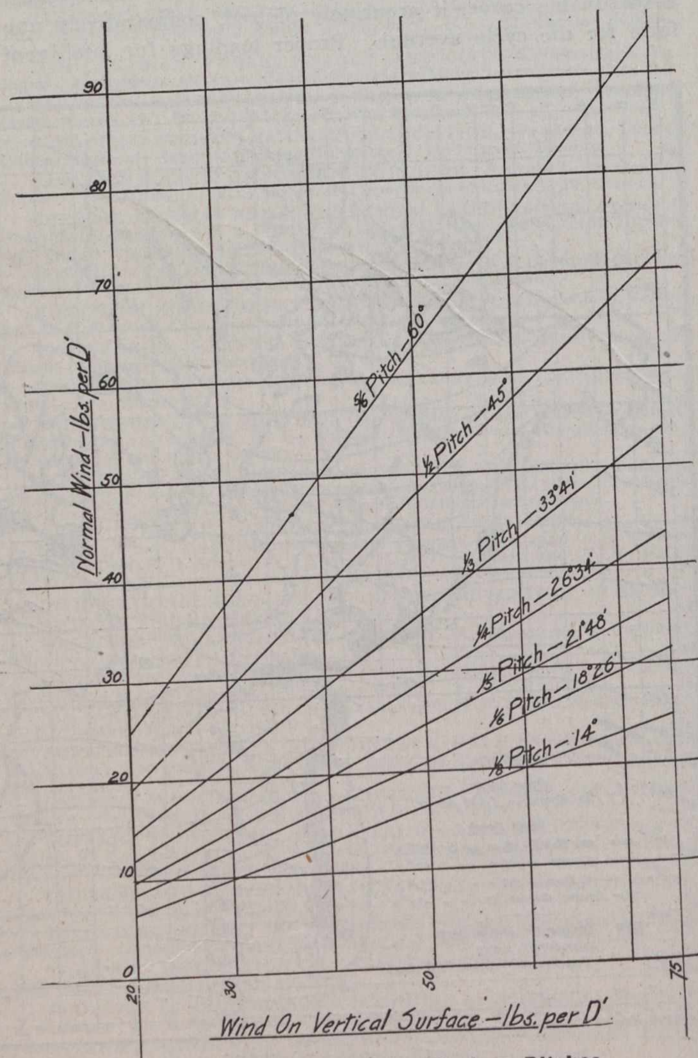


Fig. 3.—Wind Loads for Various Pitches.

necessitating exceptional foundations and diagonal bracing for buildings in these regions, it is beyond the scope of intentions in presenting the map chart and explanation.

The chart feature shown has been for some time employed in the engineering department of a large structural steel concern. The writer has embellished it where deemed essential, deriving the various curves shown from the formulas regularly used by this company.

THE PROTECTION OF THE FORESHORE AT DALLAS ROAD, VICTORIA, B.C.

The protection of the foreshore at Dallas Road, Victoria, B.C., has been the object of considerable work on the part of the Public Works Department of the province. Mr. G. M. Duncan, in a paper read before the Canadian Society of Civil Engineers, on November 7th, 1912, describes the work which has been done. The following abstracts are taken from the paper:

For several years the sea had been encroaching upon a part of this roadway, which runs along the coast overlooking the Strait of Fuca, with the consequence that the banks were gradually being eroded. In 1903 the city authorities commenced to build a low concrete wall to form some protection, and they continued building it in sections until it was about 1,500 feet in length in 1906. This wall, which had a height of 6 feet above high water, did not, however, prove of much service against the heavy seas which are prevalent during certain parts of the year. In 1910 the roadway was getting into a serious condition and the city authorities saw they would have to take immediate steps to form some permanent protection. A by-law was passed authorizing the expenditure of $75,000 which was augmented by the sum of $20,000 from the provincial government for the purpose of erecting more suitable protection works. The city authorities were in favor, and had the intention of building on top of the old wall, a proposal of which the public works engineer did not approve on account of the unstable condition of the foundations and general state of the wall.

After close investigation into the local conditions and a careful study of the various types of walls elsewhere constructed with similar objects, the conclusion was arrived at that protection could be most effectively and economically attained by a vertical wall carried down into solid ground below low water mark, except at its termination where it was anticipated the depth might be materially reduced. Trial sections of a solid and of a reinforced concrete wall were made and it was found that the cost of the former would considerably exceed that of the latter.

A comparison was then made between walls with counterforts 16 feet and 20 feet apart, respectively, and the balance in favor of economy proved to be for the latter. It was therefore decided that the wall should be vertical, carried up to the level of the roadway, of a reinforced concrete type without a base plate, with counterforts at 20 feet centres, and with a belt of granite in its face where the wash of the sea was greatest.

The calculations for the strains and areas of steel and concrete were then commenced and the following assumptions made:—

That all steel used would have an elastic limit of 32,000 lbs. per square inch.

That all rods should have a working stress of 12,000 lbs per square inch and be capable of being cold bent, 180 deg. flat on themselves.

These assumptions were subsequently required by specification.

The sketch shows typical sections of the wall and counterforts. The reinforcement in the wall consists of horizontal rods 1 foot apart commencing with ¾-inch diameter at 2 feet from top of wall and increasing in diameter with the depth of wall. These rods are link jointed and are kept in place between each counterfort by two face plates each ⅜ in. x 4 in. at 6 feet 8-inch centres. To the horizontal rods is wired expanded metal and No. 16, 1-inch mesh was at first used for this purpose but No. 10, 3-inch mesh was afterwards substituted on account of the former being found to be too light and the mesh too small.

The counterforts are reinforced in the same manner as the wall with horizontal tie rods hooked into face and back plates. It should be pointed out here that these tie rods and also the horizontal rods in the wall are subject to shearing stress at their connections with the face and back plates of the former and at the link joints of the latter, a point which is very easily overloaded. The back plates consist of 6-inch plates, ¼-inch and ½-inch riveted together.

At each counterfort the horizontal rods in the wall were at first placed between the face plate and the hooks of tie rods, but it was afterwards found that a more secure method was to place them at back of face plate and resting on tie rods of counterfort to which they were securely wired, and this method was adopted throughout the rest of the work. The bottom of all face plates are split and spread, and at

The Dallas Road Sea Wall at Victoria, B.C.

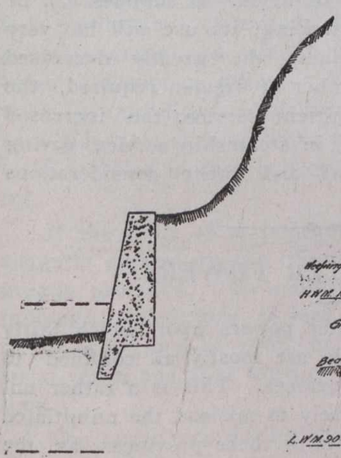


Fig. 1.
Section of Old Wall.

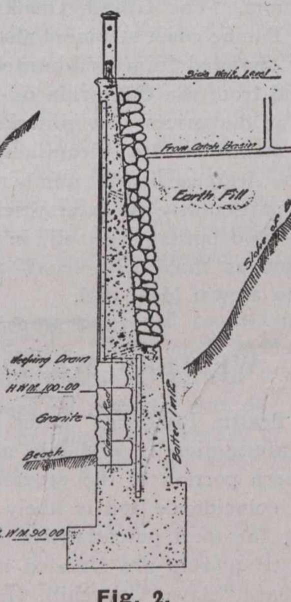


Fig. 2.
Section AB.

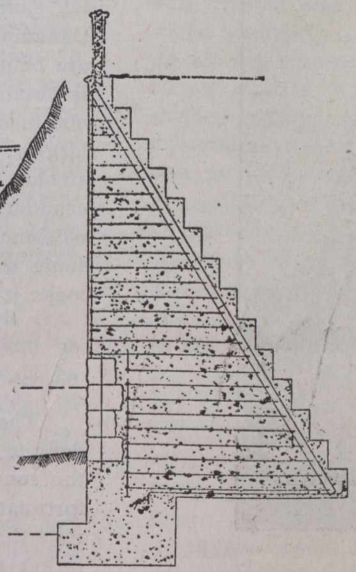
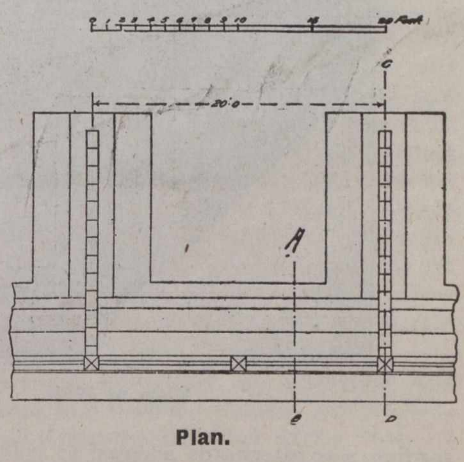


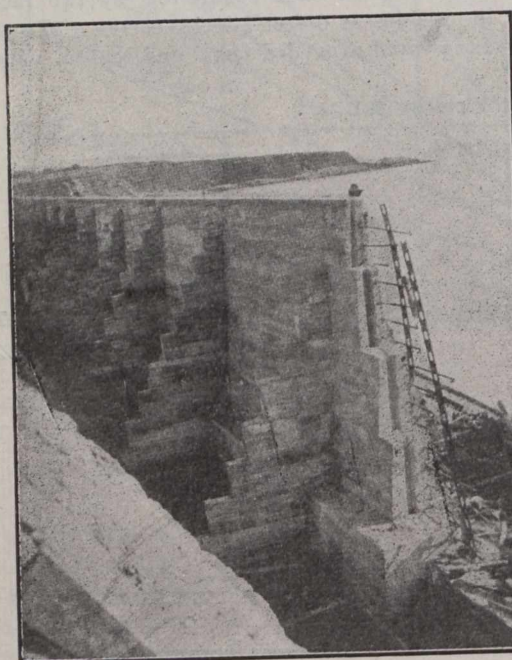
Fig. 3.
Section CD.



Plan.

the counterforts the face and back plates are held together by ⅝-inch bolts. The footings of the counterforts are reinforced with ¾-inch diameter rods at 4½-inch centres which are carried about 2 feet into wall and rods of same diameter at 7-inch centres and 7 feet long are placed between the bottom tie rods so as to thoroughly anchor the counterfort to footing.

To protect the wall from the wash of the sea and battering by drift logs, a belt of granite has been placed in the face of the wall as shown. Holes were drilled through the granite and ¾-inch diameter rods placed therein set with neat cement, thereby double clamping each stone. In the event of the cement mortar between the courses showing signs of disintegration the joints are to be raked out and caulked with lead wool. The lower part of the wall up to the shoulder, excluding the granite, is in the proportion of 1:3:6 concrete and all other concrete is in the proportion of 1:2:4. All concrete was of a "wet" mixture and the cement used was Portland. The exposed face of the concrete is of cement mortar in the proportion of 1 part Portland cement to 3 parts sand deposited at the same time as the concrete, and lifting plates were at first used to ensure the bond, but



View of Wall.

spading was afterwards adopted as being found more satisfactory.

At the back of the wall a layer about 1 foot thick of broken rock is placed for facilitating drainage and a weeping drain of 3-inch drain tile placed in wall between each counterfort. The length of the wall is 1,680 feet, the greater part of which has an average height of 30 feet. It is finished on top with an iron pipe railing supported by reinforced concrete posts at 10 feet centres.

The work was done by contract and the total cost amounted to $119,020, divided up as follows: Wall, $112,130; convenience and steps to beach, $3,810; railing, $3,080.,

Work was commenced in January, 1911, and completed in February, 1912, but a great deal of delay occurred and time was wasted through disputes.

The plans were prepared in the Public Works Department by the author, acting under the instructions of Mr. Edward Mohun, M. Can. Soc. C.E., etc., who designed the work. Mr. A. E. Foreman, A. M. Can. Soc. C.E., was supervising engineer, and the contractor was the Pacific Coast Construction Company, Limited, Victoria.

PETROLEUM RESOURCES OF CANADA.

While the actual petroleum resources of Canada are comparatively small, nevertheless the potential resources are considerable.

In New Brunswick and Nova Scotia there are enormous deposits of oil shales which are valuable as a source of oil. On an average these shales will give a higher yield of crude oil than the oil shales worked so extensively in Scotland.

In the vicinity of Fort McMurray and Fort McKay on the Athabaska River, Alberta, there are enormous deposits of tar sands. The bitumen in the tar sand is the residue from evaporated petroleum and it has been estimated that there is 6½ cubic miles of solid bitumen in the tar sands exposed on this river.

Although enormous quantities of oil have evaporated from this district, nevertheless it is probable that accumulations of petroleum exist where the geological structure was such as to prevent its escape. This is also substantiated by the fact that natural gas occurs in quantity in districts where the tar sands are capped by overlying measures.

If large quantities of petroleum were discovered in Alberta, it would be a factor of great importance to the railway interests which operate in the Rocky Mountains and Jasper Parks and in forest areas in British Columbia and Alberta.

The Canadian Pacific Railway is now using oil-burning engines on its main line between Kamloops and Field in British Columbia. The Grand Trunk Pacific and some of the Canadian Pacific coast steamers also burn oil, and other boats are being changed from coal-burners to oil-burners. The oil is obtained from the California oil-fields. If supplies can be obtained at the prices now prevailing, its use will be very largely extended. Its cleanliness, the greatly decreased smoke, the decrease in the number of firemen required, the economy particularly in intermittent service, the increased efficiency—two boilers with oil, in steamship service, giving same steam as three with coal—and other considerations make it an almost ideal fuel.

WESTERN WATER POWERS.

The Prairie Provinces' water powers upon which fairly definite information is available are mostly all confined to the southern portion of the provinces. This is a rather unfortunate coincidence and is likely to mislead the uninitiated regarding the total potentialities of these provinces, as the larger water-powers are situated in the north, on the Athabaska, Peace, Slave, Churchill, Nelson and other rivers. As even a preliminary survey of these rivers will be of great value, the Commission of Conservation has undertaken this work. During the last two summers, its Hydro-Electric Engineer, Mr. L. G. Denis, has been in the field making measurements of flow, height of falls, etc. Last year, the many rapids of the Athabaska River were investigated and the flow of the Peace and other rivers was measured. This year, the work included many long miles of travel, mostly by canoe, the western limit of the trip being the Peace River canyon in the north-eastern portion of British Columbia, while the northern limit was Fort Smith, on the Slave River. On the return trip the several rapids and falls in the Clearwater River and the upper waters of the Churchill were investigated. The general impression created by these large northern water-powers is that they will undoubtedly become of great value in connection with the wood-pulp industry. The raw material is close at hand, the only retarding factor, at present, being the lack of means of transportation and access. The details obtained by these investigations will be included in the Commission's forthcoming report on the "Water Powers of Western Canada."

MAINTENANCE AND REPAIR OF NEW YORK STATE HIGHWAYS IN 1911.

The following notes on the work done by the Bureau of Maintenance and Repair of the State Highway Commission of New York during the year ending December 31, 1911, have been taken from the last annual report of the State Commission of Highways:

Patrol System.—During the year there were 2,622 miles of improved state and country system of highways under the jurisdiction of the bureau. All of the minor repairs are cared for by the patrol system comprised of 594 patrolmen in charge of patrols of 5 miles average length. These patrolmen work under the supervision of highway inspectors in charge of sections of approximately 100 miles of roads each. These highway inspectors in charge of sections report in turn to superintendents of repairs in charge of the work in each division, the state having been subdivided into six divisions.

These patrolmen are required to furnish a horse and cart together with necessary small tools and to work upon his section between the hours of 8 a.m. and 5 p.m. In general the maintenance work done under the patrol system may be described as all work necessary to keep the surface of the paved roadway in as nearly perfect condition as possible, keeping the earth shoulders smooth and safe for traffic, the entire drainage system free from obstructions, noxious weeds and brush cut within the limits of the highway, small repairs to structures and guard-rail. In addition to these duties the patrolmen in numerous instances made surface applications of various dust layers upon the improved roads as granulated calcium chloride, glutrin and in some cases did surface oiling. Also they perform considerable work in unloading and delivering along the roads maintenance materials such as stone and oil. The number of miles to be patroled in 1912 is 3,151 and the number of patrolmen 698.

If the work of maintaining improved roadways is consistantly carried on the effective life of such roads will be greatly extended. It would appear as though it could be prolonged indefinitely, if year by year the material added to the road surface be equal or slightly in excess of the material which has been worn away during the same interval of time.

The experience during the years of 1909, 1910, 1911 has demonstrated that results of the patrol system has thoroughly justified its existence. The average cost for the entire state per mile for patrols for 1911 was $140.

For the season of 1912 it was proposed to subdivide the maintenance and repair work of the state into eight divisions instead of six, this change being necessary to give proper supervision to the rapidly increasing mileage of the improved state and county system of highways, also to have all the work in each county as far as possible under the direct supervision of one foreman or inspector, also to do most of the extensive surface piling and other repair work by contract. It is also proposed to do better and more permanent surface oiling treatment, substituting for the previous light oils applied cold with light cover costing about $500 per mile, a much heavier grade of bituminous oil applied hot covered with ¾-in. crushed stone and then rolled with steam roller costing about $1,000 per mile. This treatment in addition to being more durable avoids the criticism caused by the light cold application tending to soften up during continued wet weather, producing a sloppy condition which has been very much objected to by both vehicular and pedestrian traffic. While the first cost of this surface treatment is an increase over previous practice it is expected that in the long run it will result in a decrease of the total maintenance charge over a long period of time.

In 1911 there were resurfaced 48.23 miles at a total cost of $312,449, making the average cost per mile $6,509.

This resurfacing consisted of scarifying, placing stone and bituminous top dressing.

The total number of miles oiled in 1911 was 269. Total cost of oiling was $250,601; average cost per mile for oiling was $932.

The following is a summary of the result of the experiments:—

Oiled Surface Treatment Using Trinidad Liquid Asphalt "AA," Genesee County Road No. 586.—The summer season of 1911 was far advanced before the programme of surface oiling which had been laid out for the season's work was begun. It was determined to treat the surface of various roads with Trinidad Liquid Asphalt "AA" instead of the ordinary bituminous material C. O. and this was done upon Genesee county road No. 586 during September and October.

The usual methods for applying C. O. were followed, comprising sweeping the macadam clean of all mud, dust and loose material, followed by minor surface repairs to ruts, depressions, etc., with ¾-in. crushed limestone, the surface then being treated with Trinidad Liquid Asphalt "AA" which had been previously heated on account of the cold weather due to the lateness of the season so as to flow freely. Long stretches of one-half of the width of the road were treated and covered at a time so as to interfere with traffic as little as possible. The material used for covering the oil was rescreened or dustless limestone screenings. The oil was applied at the average rate of ⅓ gal. per square yard surface and the completed cost of the treatment, including all material and labor was $0.07½ per square yard. The oil cost in tank cars f.o.b. siding at delivery points $0.06¾ per gallon average. The stone for cover cost f.o.b. siding at delivery points $0.975 per net ton average. The total quantities of materials used were 988 net tons stone and 16,030 gals. oil. The width of the treated surface was 16 ft. and the length was approximately 5.2 miles. At the close of the year this surface was in excellent condition, there being no apparent tendency to mush up and become sloppy due to softening under continued wet weather. No roller was used during the prosecution of this work and the results were very satisfactory. The work was carried on under the patrol system the supervision of the Bureau of Maintenance.

Experimental Pavement Consisting of Limestone Top Course Macadam Bound with Glutrin.—Hudson Avenue, Sec. 1, Road No. 15, was originally improved during 1900, its length being 3,326 ft., or 0.65 mile at an expense of $7,242.67, or at the rate of $11,370 per mile, the surface being 16 ft. wide, the foundation course being of crushed limestone 4 ins. thick and the top course crushed trap rock 2 ins. thick, all water bound. The traffic carried by this road is exceedingly heavy, heavy loaded horse-drawn trucks of market produce, and sand and gravel from local pits predominating. The resulting wear required extensive repairs from time to time.

The cost of maintenance previous to 1907 was $6,376.40; expenditure in 1907, $277.81; in 1909, $2.25; in 1910, $542.27; in 1911 previous to this work, $46.55, making a total cost per mile per year for maintenance, $1,045.

During 1910 and 1911 the road was in a bad condition, depressions and ruts through the entire length of the roadway. This having been brought to the attention of the department during the latter part of September, 1911, it was decided to resurface the road with limestone bound with limestone dust and glutrin in solution, the general plan proposed being to fill up the depressions and ruts with coarse broken stone, restoring proper crown to the remaining old macadam and treating this as a foundation upon which to construct a macadam top course 3 ins. thick after rolling, this construction being adopted on account of amount of available funds preventing any more permanent construction. The work was carried on by County Superintendent J. Y. McClintock by the pay-roll system under the general supervision of the Maintenance and Repair Bureau.

The following points are taken from the specification for repair:

The upper course is to be composed of No. 3 limestone of an average thickness of 3 ins. After this is rolled and filled, spread over it ¾ lb. of pulverized feldspar per square yard of surface, and mix it in with the limestone by means of rakes. Roll with steam roller. Sprinkle with mixture composed of one part glutrin and three parts water, so as to get ½ gal. of glutrin into each square yard of the surface. Roll it until the stones are firm enough to walk over without any apparent movement.

For wearing course spread on limestone screenings. Put on enough to thoroughly fill the crevices between the stones. This will require thickness of about ¾ in. Now sprinkle with water and roll as usual until about one-half of the amount of water necessary has been applied. Then finish the sprinkling, and wet rolling with mixture of one part glutrin and three parts water. Now put sprinkling cart ahead of the roller and put on enough of the mixture to thoroughly flush the surface and wash the dust and small stones into the crevices. You cannot get the surface too wet, and you cannot roll too much. Keep on wetting and rolling until the surface puddles, which really means that it will not take in any more of the glutrin and water, the plan being to use about ¾ gal. of glutrin per square yard of completed road. Just before the surface dries, and this may be three or four days or a week later, the sprinkling cart should be filled with the mixture of one volume of glutrin to one of water, and the flow so regulated as to spread only 9 ft. wide. Sprinkle until ⅓ gal. of water or ⅔ gal. of mixture is applied to each square yard of the middle 9 ft. of the road.

This work was begun during the latter part of the month of September and progressed through October and November, when it was necessary to shut down for the season, due to the setting in of freezing weather. This necessitated building a portion of the road without glutrin in order to make it passable for the winter, with the idea of concluding the glutrin treatment in the spring.

The entire expense for this construction for the season's work, including all of the materials necessary to finish it up in the spring, is:

Use of steam roller	$ 392.23
Labor	873.12
Teaming	1,077.87
2,616 tons of stone	2,051.49
3,352 gals. of glutrin and crushed feldspar	403.58
Miscellaneous items	14.51
Total	$4,812.80

The number of square yards treated was 5,913, making an average expense of 81.4 cents per square yard of surface. It is fair to state that a portion of the labor, possibly one-quarter, should be charged to fixing the shoulders and ditches. A portion of this road, a few hundred feet upon which the glutrin was placed, was entirely constructed of No. 2 stone, and before winter set in, it showed signs of displacement because of being so small.

Glutrin was first used in Orange county in 1910 on roads Nos. 44, 93 and 160. The results were as follows:

On road No. 44, Goshen to Florida, the product worked especially well. About one mile of road on No. 44 is macadam. Before the application of glutrin this section of the road ravelled badly every year. The glutrin seemed to have a binding quality and the macadam section held tight the entire season of 1910. On the gravel section the product worked well as a dust layer. About the only fault one can find with it is that it is soluble in water and one or two days' rain causes it to move to the shoulders of the road. The results on road No. 93 were about the same as on road No. 44.

The department considered it satisfactory on roads Nos. 44 and 93 in 1910 and it was recommended for use on these roads for 1911. The residents seemed to like the glutrin and many citizens in the village of Florida ordered it in barrels for use in front of their dwellings.

On road No. 160 the results were not so good as on Nos. 44 and 93.

The chief complaint from the public was that after rains it left the road in a soft and sticky condition. It is believed this was partly due to the poor material used in the construction of the road. The supervisor and several citizens requested that oil be used in the place of glutrin in 1911 and oil was recommended for No. 160 this year.

Glutrin was used again this year on roads Nos. 44 and 93 and is giving such good results that the first deputy in charge of maintenance has recommended its use next year. The people along the roads seem to be particularly well satisfied with it this season and many requested its use in 1912.

Details of various experimental pavements in Munroe county, among which are the Rocmac on road No. 83, the Mixing Method Asphalt, road No. 94, the Kentucky Rock Asphalt also Amiesite on road No. 5, and the Cube pavement on road No. 6 were given in Engineering and Contracting of November 15, 1911. The conditions of these various surfaces one year later, after they have been under traffic for over one season, are thus described in the report for 1911:

At the close of the season 1911 the Rocmac pavement on road No. 83 in the town of Gates was in perfect condition. It has not shown any indication of either ravelling or rutting. It is only slightly dusty. Continued wet weather does not produce any mud upon the surface. The surface being quite gritty gives excellent footing for horses and also reduces the liability to skidding of pneumatic-tired vehicles. Maintenance expense practically nothing.

The Mixing Method, Asphalt, laid on road No. 94 at the close of the season of 1911, was in perfect condition, there being little indications of wear, the surface being very smooth. The maintenance cost on this section during the season having been nothing except for work smoothing up the earth shoulders.

The Kentucky Rock Asphalt on road No. 5 at the close of the season of 1911 was, where laid during warm weather, in good condition. However, the end which was laid during colder weather was in rather poor condition and had necessitated considerable repairs. It is evident from the results on this road that it is absolutely necessary that this material be laid during the hot summer months in order to secure good results. The good portion was generally smooth, showing, however, occasional bare spots where the stone appeared through the asphalt on the surface.

The Amiesite on road No. 5 was partially laid during both seasons, 1909 and 1910, and at the close of the season of 1911 was in good condition. However, during 1910 an effort was made over a portion of this surface to roll on a thin sealing coat of the treated screenings size material. Where this was done there was a tendency for this thin surfacing to break off. However, the pavement underneath this surfacing was found in excellent condition. It would appear that if any sealing coat is used in connection with this construction that it it should be rolled in together with the balance of the road instead of attempt being made to roll it on afterwards.

At the end of the season of 1911 the vitrified shale cubes laid in 1909 on Road No. 6 were still in good condition and showed but little effect from wear. The Portland cement concrete cubes made with soft gravel and laid the same year showed the effect of wear but still preserved a good smooth surface, except for a short stretch of 100 ft., where they had broken up. The reason for this break seemed to be a weakness of a foundation. The concrete cubes made in moulds very wet, which were laid in 1910, were found to be soft in the spring of 1911, and did not hold up under traffic. The frost seemed to have disintegrated them. Of the ash clay cubes laid in 1909 the soft burned ones did not stand up well, but the ones made with small amount of Jersey clay mixed with local clay and ashes were in good condition.

This piece of road was subjected to very hard usage by the frequent passage of heavy agricultural engines with very sharp lugs on the wheels. It seems to be demonstrated that with cubes made tough enough to stand the wear of traffic, this form of pavement will be cheap and satisfactory.

THE EFFECT OF SAFE WATER SUPPLIES ON THE TYPHOID FEVER RATE.*

Disasters have occurred from drinking sewage polluted water due to three distinct reasons:

One.—Failure to purify a surface supply exposed to pollution.

Two.—Inefficiency of the purification.

Three.—Failure to supply the purified water to all parts of the city.

Failure to Purify.—The failure to purify a supply which is polluted or exposed to sewage pollution may usually be attributed to an undue confidence in a supply which is safe "most of the time." It is difficult to impress upon municipal officials, without a severe lesson, that to avoid disaster it is necessary to have a water supply safe 365 days in the year. It is difficult to make them see the necessity for purification when the supply may be safe 350 or 360 days in the year.

They consider the expense almost unjustifiable when the menace only exists for four or five days in the year. But when disaster occurs they are willing then to spend the money after the damage is done. Erie, Pa., extended their intake pipe far out into the lake. It was nearly five miles from the nearest source of pollution. During 1909 and 1910 there was no evidence of serious pollution, but in December, 1910, such pollution occurred, and was followed in the early months of 1911 by 135 deaths and over 1,300 cases of typhoid fever.

There is too much confidence placed in unfiltered surface supplies from inhabited watersheds. Even where there is alleged control of the watershed and ample storage, pollution may occur. In regard to unfiltered surface supplies the need of bacteriologic control is very evident. Dangerous pollution may be present only for a few days or for a few hours. This is most likely to be disastrous in time of drought or low water. At such times the diluting effect of the inflow and the purifying effect of storage are both reduced to the minimum. The bacterial count per cubic centimeter is valuable, but the quantitative estimation of B. coli is of far greater importance. A low count does not necessarily imply a safe water, but a low count coupled with absence of B. coli may be considered an index of safety.

The typhoid epidemic in Baltimore in 1910 was coincident with prolonged drought. The run-off from the watershed of the Gunpowder River was reduced to the minimum. The sewage pollution was thus concentrated, and gross pollution was evident upon bacteriological examination. B. coli was frequently found in 0.1 of a cubic centimeter, and sometimes in 0.01 cubic centimeter samples. When the run-off increased, affording greater dilution and increased storage, the water returned to normal and the typhoid fever dropped to a minimum.

In Europe, surface supplies are almost invariably filtered, and eventually such supplies in America will be treated or filtered.

The factors affecting sewage pollution of a water supply and which determine the relative danger to be anticipated for such pollution are:

The amount of polluting material, the presence of pathogenic organisms, the time of transit from the source of pollution to the waterworks intake, and the amount of water available for dilution.

Provided the amount of polluting material is considerable, that typhoid fever is prevalent on the watershed, and at the time of transit is within the bounds of time deemed necessary for the natural death of bacteria, pollution of the intake will take place. The last factor, the amount of dilution, will determine the intensity of the pollution. If the polluting material is great in amount, and if a swift current cuts down the time of transit, prevents sedimentation and retards dilution, then gross pollution results.

With a dilute pollution one need not expect a great explosive outbreak, but many cases of typhoid may result, especially following floods and rains. Often in the absence of explosive outbreaks in the winter or spring months it will be demonstratable that too many deaths from typhoid fever occur in the first half of the year. On the other hand, it is reasonable to suppose that the dilute infection may be responsible for many scattered cases which can not be traced to water.

These cases may not appear in sufficient numbers in any particular month to be remarkable or they may be obscured by occurring in the months when typhoid fever is accepted as an inevitable visitation.

Water may be responsible for many cases of typhoid when it is impossible to prove the case against it. We are able to fix the guilt on the water supply only in massive outbreaks of explosive character, but smaller doses can be responsible for smaller outbreaks or many cases spaced over a long period without any hope of proving this causation.

It seems quite probable that a dilute pollution of a water supply with typhoid organisms may exert an influence indirectly through the agency of milk. The very few organisms in the water through multiplication in the milk may be enormously increased.

Inefficiency of the Purification.—There seems to be an impression that the installation of the filter plant means safe water. This is not necessarily true.

The filter plant must be properly constructed and intelligently and efficiently operated. I have seen filter plants that were structurally perfect, intricate mechanisms designed after plans by our best engineers, yet these plans are sometimes placed in the hands of an assassin, entirely innocent of knowledge of the proper bacteriologic control of his plant.

Poor filter efficiency is often responsible for disaster in the shape of typhoid outbreaks, and may be due to several

* Abstract of address delivered by Dr. Allan J. Mc Laughlin, United States Public Health Service, Washington, D.C., at the Sixth Annual Meeting of the Association of Life Insurance Presidents in New York City, on December 5th, 1912.

causes. The slow sand type may give poor filter efficiency when sufficient extra units are lacking, necessitating excessive rates and placing of "green" filters in service. Excessive rates, too little coagulant, insufficient sedimentation capacity, and insufficient storage are common operating and structural faults of the mechanical type. Sometimes a properly constructed plant is struggling with a raw water which has a high bacterial content, and even with fair filter efficiency yields an unsafe effluent. Probably the greatest single cause of a poor effluent from filter plants is inefficient operation by unskilled men. It is absolutely essential for good results that bacteriologic examination, including B. coli estimation, be made at least once daily, and in slow sand plants from each unit separately.

The man in charge must be able to do this. In mechanical filter plants, or with hypochlorite plants, he must also have the necessary skill to adjust his chemicals with a nicety according to the changes in the raw water. With such a man in charge of a properly constructed plant a safe effluent is assured at all times. When struggling with a bad raw water, he will use hypochlorite as an adjuvant with good results. He will study the peculiarities and fluctuations of the constituents of the raw water and adjust his treatment accordingly.

In showing the relation between water and the prevalence of typhoid fever it is essential to have accurate vital statistics. Too often we find in making an investigation that no accurate statistics are available. Happily the registration area is growing larger each year, but the enormous territory still outside the pale, which furnishes no statistics, is a disgrace to our civilization and our much vaunted progressiveness.

The Federal Government can only request such statistics as a courtesy, but surely in this day and generation no authority should be necessary to compel the furnishing of statistics to the General Government for the general welfare.

Failure to Supply the Purified Water to All Parts of the City.—To secure the desired result, elimination of water-borne typhoid, it is essential to supply the safe water to all parts of the city. The high typhoid rate in Toledo, in spite of a safe public supply, was due to the fact that more than half the population depended upon shallow wells which were known to be contaminated in many instances. In Pittsburg during 1910 wards 1 to 20 were supplied with filtered water. The aggregate population of these 20 wards was 401,622. The typhoid-fever death rate per 100,000 in 1910 was 13.4. Wards 21 to 27 comprise the old city of Allegheny, and have a total population of 132,283. This section received unfiltered water. The typhoid-fever death rate per 100,000 in this section in 1910 was 46.9.

To summarize, the following facts are pertinent:

One.—In the prevention of typhoid fever there is a necessity for safe water supplies for 365 days in the year.

Two.—Unfiltered surface supplies may be exposed to a dangerous pollution for a few days or even for a few hours only.

Three.—Supplies derived by impounding surface waters, and which depend upon storage alone to nullify the pollution of an inhabited watershed may be very dangerous in periods of drought and low water. The proportion of pollution is relatively greater at such times and the time of storage is greatly reduced.

Four.—Purification, whether by storage, filtration, or chemical treatment, must be efficient at all times, and this cannot be assured without bacteriologic control.

Five.—It is essential that a daily quantitative estimation of B. coli be made, as a low bacterial count does not necessarily mean a safe water without absence of B Coli.

Six.—There is a necessity for close supervision of municipal plants by the State to correct structural and operative defects and insure a safe water at all times.

Seven.—Bacteriologic control and State supervision would insure cleaning when necessary, and should prevent the putting in service of slow sand filters before the "schmutzdecke" is ripe.

Eight.—In order to control typhoid fever and eliminate water-borne typhoid it is not sufficient alone to have a purification plant. In addition the purification must be efficient and the purified water must be available in all parts of the city.

It has been said that every death from typhoid fever was either a case of murder or suicide. An even stronger statement has been made that for every death from typhoid fever somebody should be hanged. These statements have a strong basis of truth, but exceed the truth somewhat. A more conservative statement, and one which is unassailable, is that every case of typhoid fever is due to somebody's ignorance or carelessness.

Now, in regard to carelessness or criminal negligence, the punishment should fit the crime, but for ignorance the remedy is not punishment but education.

It is precisely in this matter of education that this powerful and intelligent association can achieve the greatest good. The educational campaign must be directed against improper disposal of human excreta, impure milk supplies, flies, uncontrolled cases of typhoid, filthy personal habits of individuals, and, above all, against contaminated public water supplies. This paper is limited to water-borne typhoid, and therefore the other very important factors are not discussed. In the campaign for better water supplies we must direct our efforts toward securing the co-operation of the municipal authorities and the individual citizen.

Municipal authorities must be impressed that it is their plain duty to furnish a public water supply which is safe 365 days in the year and not on which is safe "most of the time"; that the absence of large explosive epidemics is not proof that the water supply is safe; that dangerous pollution due to a combination of weather and other conditions may occur only one day in the year, as at Erie, Pa., and that such disasters must be prevented; that a dilute pollution may be responsible for cases of typhoid fever scattered throughout the year, without giving an abnormally high typhoid rate; that a public water supply cannot be assumed to be safe, unless it is shown to be safe by a daily bacteriological examination.

In regard to the individual citizen, he must be awakened to the seriousness of the excessive typhoid fever rate in this country. In so far as water-borne typhoid is concerned the citizen should be taught that municipalities have an obligation to furnish a public water supply which is safe 365 days in the year, and that it is his inalienable right to demand and receive such a supply. The standard which should be expected in order to indicate safe water should be, less than 100 bacteria per cubic centimeter and an absence of the Colon Bacillus or other bacteria of sewage origin in one cubic centimeter samples.

The following are the lines of the Canadian Northern Railway now under construction:—

Line.	Miles.
Sydenham-Ottawa	86
Montreal-Hawkesbury	60
Roberval Extension	30
Ottawa (Rideau Junction)-Capreol Junction	304
Ruel-Port Arthur	543
	1,023

COMPRESSED AIR STORAGE IN ROCK.

In a recent issue of the Engineering and Mining Journal Mr. Frank Richards, of the Ingersoll-Rand Company, 111 Broadway, New York, gives some interesting data regarding compressed air storage in rock. We herewith reproduce the article and illustrations.

One of the most familiar annoyances or inconveniences in the use of compressed air is insufficiency of storage capacity. In most of the employments of compressed air, especially in mining operations, the air is used intermittently and the rate of air consumption varies over a wide range. At the same time the usual air receiver is so small as to have little effect in maintaining constant pressure.

It has often been proposed and also many times attempted to use old and abandoned workings of mines for air-storage purposes, but in many cases complete failure has resulted on account of the impossibility of making the rock air-tight. It is, therefore, a pleasure to call attention to at least one instance where this scheme has worked successfully. The storage capacity in this case is a hundred times that of the largest commercial air receiver usually furnished.

Fig. 1 shows the essential features of a crosscut and drift on the 700-ft. level of the Centre Star mine of the Consolidated Mining & Smelting Company, of Canada, Limited, Rossland, B.C., which has been fitted up to serve as an underground receiver. In this case the rock was so close

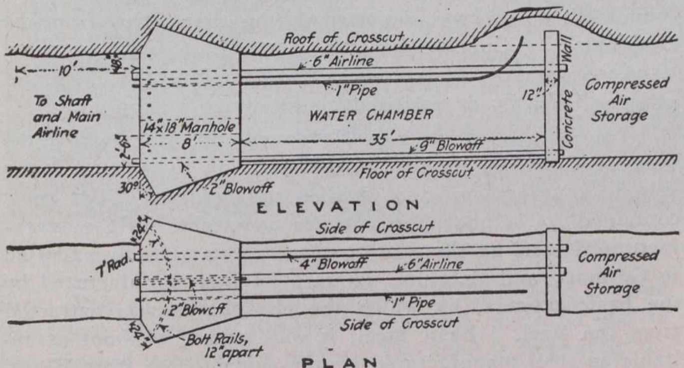


Fig. 1.

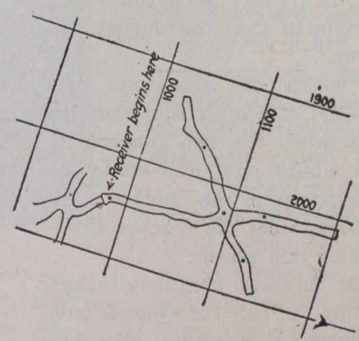


Fig. 2.

Compressed Air Storage in Abandoned Drift.

grained and free from fissures that the leakage was inappreciable. Fig. 2 is a plan of the workings appropriated for the receiver, the dam being placed as indicated. At this point the rock was notched out so as to give a bearing at least two feet wide all around to take the thrust caused by the air pressure, which aggregated about 450 tons. The dam was made of concrete eight feet thick, reinforced as seen in Fig. 1, by nine horizontal arched rows of 30-lb. rails. A manhole, 14 x 18 in., was run through the middle of the dam and secured by a cover on the inner face.

Inside the dam, with a space of 35 ft. between, was erected a concrete wall 12 in. thick to form a water chamber between it and the dam. It will be observed that this wall had to resist only the water pressure of four or five pounds at the most, the air pressure being effective equally on both sides, communication being free over the top of the wall.

The air communication between the main air line and the storage chamber was through the 6-in. pipe, this passing through the water chamber on the way. Any water which might accumulate in the bottom of the storage chamber could be drawn off through the 4-in. blow-off, while the 2-in. pipe would discharge the water from the water chamber when required. The function of the 1-in. pipe is not clear, but it could be used, like a try-cock on a steam boiler, to show whether or not the water was up to the turned-up head of the pipe.

How the water chamber was kept filled does not appear, but a pump must have been required for the purpose. It does not appear in fact how much the water scheme was used, Fig. 1 being from a blueprint made before the storage system was put into use. The air, so far as the storage function was concerned, was entirely independent of the water and we know that the storage is a permanent success. All necessary valves and gauges were, of course, provided outside to keep the engineers fully informed and in full control. For the information embodied in this article I am indebted to George A. Ohren, of the Canadian Ingersoll-Rand Company, Vancouver, British Columbia.

LAYING NEW INTAKE PIPE AT MONTREAL.

The new intake for the water supply of the city of Montreal consists of double lines of 72-in. lock-bar steel pipe, laid on the bottom of the river from shore to the intake piers built in the St. Lawrence River just above the head of the Lachine Rapids where the water has a very swift current and is 32 ft. deep at high water. The work was described in a recent issue of the Engineering Record. Trenches from 7 to 10 ft. deep were excavated in the very hard, compact sand by a 2½-yd. dipper dredge moored by spuds and anchored by two 1-in. steel cables and one 1¼-in. cable.

The pipe, 9/16 in. thick, was manufactured in 28-ft. lengths by the Stewart & Lloyd Company, Glasgow, Scotland, and at the site was riveted up on shore to 140-ft. lengths and butt-strap joints. The ends were closed with temporary wooden bulkheads and the pipes were rolled from the wharf, dropping about 5 ft. into the water and were towed to position. They were lifted clear of the water by two floating derricks, the bulkheads removed, and were then lowered into the trench, where they were connected by divers who united them with gasketed flange joints. The joints were made up with bolts inserted by the divers who fitted the nuts to them and set ratchet wrenches on them operated by lines from the boats above.

Each of the double lines of pipe were connected to a 22 x 62-ft. concrete intake pier 30 ft. high which was built after the pipes were laid. Open caissons, with 12 x 12-in. timber walls, were floated to position, filled to a depth of 4 ft. with concrete, and sunk in pits dredged to solid rock. The caissons were pumped out and the concrete piers built in them in the usual way in forms, 8 ft. in diameter, with holes left opposite the ends of the intake pipes.

Sections of 6-ft. steel pipe 12 ft. long were set in the pier openings, projecting into the interior walls, and the movable outer walls of the caissons were detached and floated away. Divers descended outside the intake piers and connected to the short pipes tackles which were operated by floating derricks to lift them and connect them up to the ends of the previously laid lock-bar pipes. The divers then sealed up the annular space around the pipes and both faces of the pier walls, after which the space around the pipe in the wall was grouted through holes left for that purpose in the concrete. The pipe in the trench was protected by a covering from 1 to 4 ft. deep, thus completing the work in about 4½ months with an average force of 50 men. Mr. George Janin is the city engineer, Mr. Thomas G. Lesage is the superintendent of waterworks and Laurin & Leitch, Montreal, were the contractors.

POWER SITUATION IN QUEBEC CITY

The large undertakings now under way, or in contemplation for Quebec city and surrounding district, have served to draw particular attention to the power situation at the ancient capital. At present, the Quebec Railway, Light, Heat and Power Company is obtaining about 5,000 horse-power at Montmorency and 1,500 horse-power from the Chaudiere. It had also been obtaining from 2,000 to 2,500 horse-power from the Jacques Cartier, but a short time ago the power plant of the Jacques Cartier Company was destroyed by fire and as yet the company has not proceeded with the reconstruction of the plant owing, undoubtedly, to arrangements that have been made for securing power elsewhere. This gives the Quebec Railway a combination of between 8,500 and 9,500 horse-power.

Recently, two new companies have come into the field, the Dorchester Electric, a small concern which, when connected, will have an output of about 1,500 horse-power, and the Stadacona Hydraulic Company, which will at the outset develop 10,000 horse-power from its powers at Seven Falls, and have so laid out their development that the output will be increased to 15,000 horse-power.

Owing to the large contract which the Stadacona Hydraulic has with the Quebec Railway, it was at first thought that there was some connection between the two companies. There is, however, no connection whatsoever, and while the Stadacona will sell a portion of its power to the Quebec Railway, it may indeed be a competitor against the Quebec Company for a portion of the balance of this power.

The development carried out by this new company brings about an entirely new condition in the city of Quebec and surroundings, as it will have an output in excess of all other companies combined and, in a measure, will be able to meet the requirements of a number of larger enterprises which will be established during the next few years. The Stadacona Hydraulic Company already has its output of 10,000 horse-power disposed of, 4,000 horse-power being under contract to the Quebec Railway, Light, Heat and Power, and 6,000 horse-power to the Bayliss Pulp and Paper Company. The Stadacona also has the right to enter the field in the city of Quebec, but the intention of the company at the present time is to be a wholesale concern only, turning over its output to large concerns, or to some of the existing power companies for distribution, thus occupying the same position as regards Quebec City as the Shawinigan Water and Power does in Montreal.

In view of the number of large undertakings now being provided for, it would seem as though the interests identified with the Stadacona Hydraulic had not carried out their plans for the new installation a moment too soon, and the new Harbor Commission of the city of Quebec is calling for tenders for the erection of a 2,000,000 bushel elevator which will take 3,000 horse-power to operate it. The Hon. Mr. Cochrane, Minister of Railways, has stated that the Grand Trunk Pacific intends to start in the spring of 1913 on the construction of a 5,000,000 bushel elevator which will require 8,000 horse-power. The Quebec Railway, Light, Heat and Power has closed a contract which comes into force in June, 1913, for 1,300 horse-power for the Quebec bridge, while the Transcontinental Railway shops now being erected are in the market at the present time for 3,000 horse-power.

The Stadacona Hydraulic Company will be supplying power about the middle of 1913. The large dam at Seven Falls, which is 70 feet high, has been completed, while the work has also been finished on the construction of the 8 feet penstock which extends a length of 3,200 feet. This leaves only the power-house to be constructed early next spring. The entire machinery for this plant has all been contracted for, assuring its delivery well within the time required. The power of the Stadacona Hydraulic has the greatest head of any in the world, amounting to 410 feet. The next in point of height is said to be located on the White River in California, which has a total head of 400 feet.

IRON ORE SUPPLY OF EMPIRE.

Some interesting evidence concerning the demand for and supply of iron ore was given before a meeting of the Dominion Royal Commission held on November 13th, by Mr. Wallace Thorneycroft.

It was stated that most of the ore imported into Great Britain was made into Bessemer hermatite pig-iron, which was used for steel making by the acid process. For that purpose the ore must contain very little phosphorus. Great Britain imported in the year 1909, 6,326,000 tons of iron ore, of which nearly 6,000,000 tons was Bessemer ore.

Nearly 5,000,000 tons of this Bessemer ore came from Spain, and the balance from Sweden, Norway, Greece, France, Algeria and Tunis. Except 62,000 tons from Newfoundland, no ore was imported during that period from the Dominions. Cumberland and North Lancashire supplied 1,558,000 tons of Bessemer ore. Therefore the Bessemer pig-iron industry depended upon foreign ore supplies.

The Wabana deposit in Newfoundland, from which the bulk of Canada's production of pig-iron was made, was said to contain over 3,000 million tons of ore. But as it contained .75 of phosphorus it was unsuitable for the manufacture of steel by the acid process. It was largely exported to Germany and Belgium, where steel was manufactured by the basic process, by which the phosphorus was extracted from the steel. Basic steel, it was stated, was not as reliable as steel manufactured by the acid process from Bessemer ore containing less than 0.5 of phosphorus. If the basic principle were adopted in this country there would be a greater demand for Newfoundland ore. The more rapid growth of the pig-iron industry in Germany and the United States was, it was said, entirely due to the invention of the basic process.

Except in Canada there was, so far as is known, no production of pig iron on a large scale in the Dominions. The governments of the Dominions, it was stated, might, with advantage, provide more money for the geological survey of the territory under their control. There could be no more profitable investment. They should publish the results of the surveys made as rapidly as possible, and communicate advance copies to the iron and steel associations of this country, or abstracts and references to such publications.

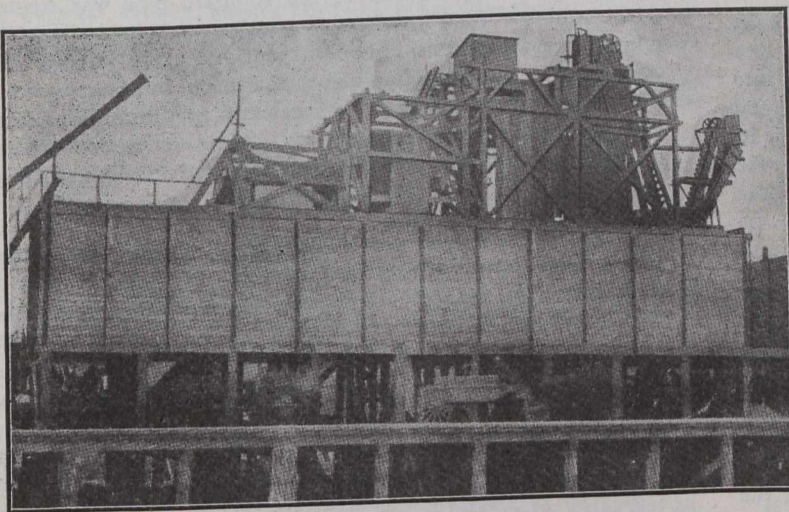
It was not suggested that the governments should undertake detailed prospecting work. The Geological Department of Canada was already very good, but with the vast area it had to cover, progress was necessarily slow.

The indication of large deposits, especially Bessemer ore, accessible for shipment anywhere in Eastern Canada or Newfoundland would promptly be investigated in detail by British makers of iron and steel and ample capital would soon be found if the deposits warranted development.

It would be right for the Dominion governments to encourage the report of iron ore. If the economic condition around the deposits were favorable, production of pig-iron and steel would naturally follow.

REPAIRING THE ASPINWALL FILTRATION PLANT.

As the only convenient source of water supply for the city of Pittsburg is the Allegheny River, the water must be thoroughly filtered before being delivered to the city mains. Accordingly, four years ago, the city spent over one million dollars in the construction of a filtration plant located at Aspinwall, Pennsylvania. This plant has been most effective in providing the city with safe and clean water. The entire plant covers 140 acres of ground and consists of a number of units called beds, covering ten acres each. Each bed in turn, comprises ten rooms, each covering one acre. These rooms are of concrete, having concrete floors and concrete roofs, these being supported by concrete columns, spaced 15 feet apart. The floor of each room is covered with several feet of sand and gravel, consisting of successive layers, varying from coarse gravel below to fine sand as the upper layer. Water, from the river, is pumped into these various rooms and allowed to slowly filter through the sand and is then pumped to the city's mains. The sand is frequently removed and washed by special machinery, which removes the sand from one room, delivers to a washer, and distributes over the floor of another room at the same time.



The Screening Plant of the John F. Casey Company.

Due to improper design and construction, considerable trouble was experienced with one of the beds of ten rooms from a seepage of water through the concrete floor. It was, therefore, necessary to remove all the sand and gravel from this bed, waterproof the floor, add several inches of concrete, wash and resize the gravel, and replace it over the floor.

The contract for this work, which involved the double handling of thousands of tons of gravel as well as the placing of a large amount of concrete, was given to the John F. Casey Company, which is one of the largest contracting concerns in Pittsburg. The method adopted by this company for handling the material, washing the gravel, and mixing and placing the concrete, allowed the work to be done in a remarkably short time and at a considerable economy.

The sand was siphoned direct from one room through the filtration plant sand washer into one of the repaired rooms by means of the sand scraping and spreading machines, which are part of the regular equipment of the plant. The sand, which could not be removed by the regular machine together with the gravel was loaded by hand into three-yard rocker bottom cars, which were hauled by gasoline locomotives to the washing and screening plant. In replacing this material in the repaired bins, it was withdrawn from the screening plant storage bins into industrial cars and hauled by electric locomotives over the top of the rooms. These cars dumped through manholes in the roof into the regular spreading cars, which deposited the material in even layers over the floor.

The washing and screening plant was located on the site of the filtration plant and was erected only as a temporary structure. The machinery equipment, however, although designed for this particular plant, was purchased with the idea of using it later on similar washing plants erected in connection with other contract work. On account of little available ground space the plant was made as compact as possible. The receiving hopper was located directly beside the bin structure and a belt and bucket elevator was placed to receive from the hopper and deliver to the screens above the bins. This elevator is equipped with 13 x 7 x 10-inch continuous buckets and the distance between head and tail pulleys is 50 feet. This elevator delivers into a chute feeding the first Gilbert screen from which it passes successively through three other screens and into a Stephens-Adamson automatic settling tank.

At this gravel had originally been washed and sized, the only object in rewashing was to remove the dust that had settled, and resizing was necessary as the various layers were necessarily confused in removing from the rooms. The city had very rigid specifications as to the maximum and minimum sizes in the various layers and the screens furnished were required to separate material according to these specifications. The size of the various bins was arranged according to the proportion of the different sizes which was definitely known.

Another part of the equipment, which assisted materially in reducing the labor cost and time on the job, was that for handling and mixing the concrete materials. A Haines concrete mixing plant was located on the site of the filtration plant, directly between the river and the railroad whereby the materials were brought to the plant. A derrick unloading rig and clamshell bucket was arranged to dig the gravel from barges and dump into a hopper above, from which it was drawn to the mixer as required. The cement was received in box cars in the usual manner and a belt conveyer was used for elevating the bags of cement to the top of the plant. The conveyer used for this was 24 inches wide by 86 feet centres using the unit ball bearing carriers.

This conveyer, as well as the complete screening plant, was designed by the Stephens-Adamson Manufacturing Company in their Pittsburg engineering office and this company also manufactured the entire machinery equipment for the plant.

WELDING PIPE WITH THE OXY-ACETYLENE TORCH.

Welding with the oxy-Acetylene torch has been successfully accomplished in the large shops for several years, but the recent installation of an 8-inch high pressure gas line in San Francisco is unique in the adaption of this process to the welding of high pressure gas mains. This work was described by Leon B. Jones of the Pacific Gas and Electric Company, of San Francisco, in a recent number of the "American Gas Light Journal." The information here given is from Mr. Leon's description of the process and the cost of its application.

The recent installation of approximately 5,000 feet of 8-inch steel tubing in San Francisco, in which oxy-acetylene welding was used on every joint, was laid under the most difficult conditions. This afforded an excellent opportunity for practically testing the adaption of welding to high pressur gas mains. This line was laid in Geary Street, at the same time that the Municipal Railway was under construction; and this, necessarily, caused many obstructions and difficulties, but in every case, the oxy-acetylene welding proved itself equal to the occasion, and all difficulties were surmounted.

There are three separate methods in which pipe may be handled when welding with the oxy-acetylene torch. Bell holes may be dug as for any coupling, and the pipe welded in the ditch, or the pipe may be lowered into the ditch and turned while the welds are being made; thus, the welding of many of the joints is done on the top of the pipe, and the necessity for digging large bell holes at every joint is avoided.

The third method, which was found the most practicable, where conditions will allow, is to put short pieces of timber across the top of the ditch at intervals, rolling the pipe into places directly over the ditch. This method insures a good alinement of the joint, and requires the least labor. With it, two men can turn as much as 500 ft. of pipe, while the operator is welding the joints, and as a 500-ft. length is about as long as can be conveniently handled, it will thus only require a bell hole and a well in the ditch every 500 ft.

While it is possible to make a good weld without turning the pipe, a great deal more time and care are necessary than when the pipe is turned, and the welding is always done on top of the joint. In welding the under side of a joint in the ditch, it is not possible to pile up the metal, as it is when welding is done on top of the joint. A joint being welded in the ditch is also more often allowed to cool before the weld is completed, and this leaves a possibility of pinholes where the weld is commenced again.

To insure against the possibility of the mold not extending through the entire thickness of the pipe, the ends of the lengths to be welded were left about ⅛-in. apart, and the operator worked with a rod of 3/16-in. Norway iron in his left hand. This iron is melted into the joint to take care of the gap, and also to build up the metal around the joint. In this way the ends of the pipe are perfectly welded, and the metal at the joint is thicker than in the pipe, thus making the joint the strongest part of the line.

To prove this statement that the weld is as strong, if not stronger, than the rest of the pipe, sample welds were made, and the pipe was afterwards flattened and bent until it was broken. In every case the break occured back of the weld in the pipe and not across the joint.

A more practical test, which will appeal to gas men, was also made as follows: Two 40-ft. lengths were supported on timbers laid across the ditch, and the ends welded together. All the supports were then removed from under one of the lengths, and the entire weight of this 40-ft. length was suspended on the joint. The weld was in no way affected by this severe treatment.

After several hundred feet of pipe are welded into a section, the supports are removed, one at a time, and the pipe reeled into the ditch like so much cable. Careful handling is no longer necessary as a weld, if properly made, will stand the same treatment as the pipe, and any defect is better detected before the pipe is covered.

It may readily be seen that, when welding the pipe on top of the ditch, into sections several hundred feet long, it is possible to work several welding outfits at the same time, with the minimum of labor. If a little care is exercised in distributing the pipe along the ditch, two men can readily roll it into place, over the ditch, for welding. In many cases, after these sections were reeled into the ditch, the ends of the sections were several feet apart. To avoid using a short piece of pipe and making two welds, a block and tackle was used, and, with an automobile for motive power, these sections, in some cases 500 ft. long, were dragged several feet in the ditch to meet the end of the next section.

As the tubing which was used on this line was approximately 3/16-in. thick, and would not permit of threading, the question arose as to how valves or governors should be connected. This was solved in a very simple manner. A short piece of 8-in. standard pipe was threaded onto a standard flange. The standard pipe, which was 8-ins. inside diameter, was then slipped over the tubing, which was 8-ins. outside diameter. After the valve or governor was installed and the flanges bolted up, the end of the standard pipe was welded to the tubing. This installation, which represented about 180 joints, was welded throughout its entire length. At the end of each day's work the line was tested to 150 lbs. pressure and allowed to stand over night. As an extra precaution the joints were also gone over with soapsuds. After completion the entire line was tested to 150 lbs. pressure and the line stood at this pressure for three days without loss.

The oxy-acetylene torch develops a flame temperature which may conservatively be estimated at 6,000°F., and it may readily be seen that with this temperature concentrated in a small pencil flame under perfect control, all metals become amenable to the will of the operator. The torch used for oxy-acetylene welding is constructed upon the injector principle, in which the oxygen and acetylene are conveyed through separate tubes to within 1-in. of the point of combustion. The acetylene is usually conveyed direct from the generator, through hose connections to the torch, at a pressure between 3 and 5 lbs. per sq. in. The oxygen, stored in tanks, is used through a reducing valve and hose connections to the torch at between 15 and 20 lbs. per sq. in. On the handles of the torches are controlling valves whereby a nicer regulation is attained. For lighting the torch the acetylene is first turned on full and ignited. Oxygen is then added until the flame becomes a single cone. An excess of acetylene produces two cones and a white color, with an access of oxygen produces a violet tint.

The hourly consumption of the torch used for 8-in. steel tubing was 24 cu. ft. of acetylene and 30 cu. ft. of oxygen. Using acetylene direct from the generator, at a cost of 1 ct. per cu. ft., and oxygen from tanks at 6 cts. per cu. ft., at which price it is now available in San Francisco, the cost of operating the torch would be $2.04 per hour and, allowing 40 cts. per hour for the labor of an operator, the total cost of operation would be $2.44 per hour. As the average time necessary to weld a joint on top of the ditch, where the welding is done on top of the pipe, is 10 minutes, the cost of such welds would be slightly over 40 cts. per joint. The time necessary to weld a joint in the ditch, where the operator was forced to weld underneath the pipe, was 28 minutes per joint, making the cost of these joints $1.13 each; but if the pipe is welded into long sections on the ground it is only necessary to have a weld in the ditch to every 10 joints welded on the ground. This would make an average cost of 49 cts. per joint, which would be approximately 2 cts. per inch of circumference on steel tubing 3/16-in. thick, and from this can be estimated the cost of welding various sizes and thicknesses of pipe, as the time per weld, and consumption of oxygen and acetylene would increase in proportion to the size and weight of the pipe.

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CONTENTS OF THIS ISSUE.

THE WATER POWERS OF CANADA.

Nearly a year has passed since the publication of "The Water Powers of Canada" by the Commission of Conservation. It was announced some time ago that another volume on "The Water Powers of Western Canada" was in process of compilation, and we understand that considerable work has already been done in the gathering of the necessary data.

We have had occasion at different times to refer to the volume already published; and, while a good deal of space has been given to it by the press in Canada, it is very doubtful whether the true value of the compilation is understood.

Probably the most valuable portion of "The Water Powers" is that dealing with the water powers of Ontario, and in particular that part which correlates the data respecting the legislation, public and private, connected with the great hydro-electric plants at Niagara Falls. This data is destined, in the future, to become more and more valuable as the work of the Hydro-Electric Commission of Ontario extends. Too much credit cannot be given to the author, Arthur V. White, C.E., for this section of the work. Perhaps no other man is as well qualified to handle it as he, and there can be only unqualified approval of the way the data has been compiled and presented. This section of the report has but to be read to appreciate the painstaking care and laborious research which he has, with an intimate knowledge of the local conditions, brought to bear on the work.

The importance of this work will be understood in the very near future. To-day at Niagara Falls 280,000 horse-power is being developed on the Canadian side by the hydro-electric companies. Of this amount 137,000 horse-power is being exported to the United States, or nearly one-half. At the present rate of increase in the use of electric power, due to the extension of the Hydro-Electric Commission system, it is a matter of a very few years until the demand will be greater than the available supply. The only complete record of agreements, franchises and legislation respecting these companies is that compiled by Mr. White, and to be found in "The Water Powers of Canada"; for that reason we feel sure it will be increasingly referred to as time goes on.

TORONTO AND PURE WATER.

Toronto citizens are being asked to vote a large sum of money in January next for the duplicating of the filtration plant recently completed on the Island.

Ever since the inception of this plant there have been many, both through the press and otherwise, who have prophesied that the plant would not come up to the anticipations of its supporters.

This journal has always held that the choice of type of filter for Toronto was not based upon any reliable or ascertained data.

Ex-Controller Dr. Harrison, Dr. Sheard and others made a short visit to the States some few years ago, visited a few slow sand filter plants, came back and put a motion through Council that Mr. Allen Hazen, of New York (a slow sand filtration expert), be employed to make plans for such a filter for Toronto.

There were many, including this journal, who concluded that the proper course to have followed would have been to carry out a few simple experiments in order to ascertain first just what was the best type of filter to suit the local conditions. This was not done. No other system other than slow sand was considered. Advocates on municipal platforms were clear and impressive in practically guaranteeing that the system would remove at least 98 per cent. of the bacteria in the raw water, with the total elimination of all intestinal bacteria. Advocates appeared to have read Allen Hazen's book, entitled "Filtration of Public Water Supplies," a book which does not treat with or give examples of filtering similar water to that which forms Toronto's water supply. Advocates appeared not to have read or even heard of the high efficiencies which were being obtained by mechanical filters with similar waters to Toronto's water supply in England, the United States and elsewhere.

What is the result? Again history is repeating itself. Toronto is being asked to go blindly into spending a huge sum of money on a system of filtering its water which has not even under trial proved efficient. The question of the efficiency of the other method is not considered, apart from a general report by the engineer, who has practically completed his plans for a second slow sand plant, and who also was responsible for the first plant.

Apart from the question of this being business, is it engineering? Engineering is supposed to be a science built on the foundation of exact data. Its conclusions are supposed to be the natural outcome of experimental findings, either in the laboratory or in practice. Where are the experimental or any other data which should encourage the citizens of Toronto in voting a large sum of money for a duplication of a plant which has required a judiciary authority to stop up its one hundred and one leaks?

Manufacturer after manufacturer of mechanical plants have practically said: "We will put you in an experimental plant; if it does not work satisfactorily, then no pay." Every manufacturer of mechanical plants has been turned down. Why? Because the city's highly-paid advisor, prejudiced to a particular type, says it is the only type. Prejudiced because he has designed the first half, and any recommendation of another type for the second half would practically mean an admission that the first half was bad in type.

Commissioner Harris is not an engineer. Therein lies his strength as an arbitrator. He can afford to pass over the amenities and nice frills of engineering etiquette, which, unfortunately, do not always make for engineering efficiency. He can afford to choose the best, independent of the fact that Engineer Hazen was responsible for the first half, and just choose that the second half be based upon pure business and actual data. Let the one type be tried alongside the other, the results made apparent, and the best chosen. Thus only can the people of Toronto be sure that when voting for filtration in January next they are giving an intelligent vote for the proven system.

Toronto can afford to wait. With chlorine at the back of the water supply, risk of typhoid is eliminated. It is a question of clearing out turbidity either by mechanical or slow sand methods.

In the first instance, however, the excessive turbidity which interpenetrates the whole subject must be removed by evidence, so that the issue be clear and above board.

The subject is further referred to in detail on page 863 of this issue.

—o—

[The following letter Mr. T. Aird Murray, consulting engineer, who was one of the board of engineers that reported on the water supply of Toronto recently, has written in answer to certain questions we placed before him. The letter is self-explanatory.]—Editor.

(To the Editor of The Canadian Engineer).

Sir,—In reply to your enquiry re the recommendation in our report upon Toronto's waterworks, with reference to recommending mechanical filtration at Scarboro' and a duplication of the present plant on the Island. Of course I can only speak for myself. As far as my memory goes, the type or character of the duplication was not seriously considered as far as the Island plant was concerned. The question of type in connection with the Scarboro' scheme was thoroughly gone into, both with reference to probable efficiency and cost. Mr. Isham Randolph along with myself, went particularly into the question of cost, and we made it that a complete filter plant could be constructed at a cost a little over $10,000 per each 1,000,000 gallons of water treated.

Your point with reference to experimental data is good, and I certainly think the city would be in great error in spending any sum for absolute duplication of the present plant until it is made perfectly clear what the reasons are for the extraordinary variations in efficiency which have been peculiar to the Toronto plant ever since it has been operated. It also appears reasonable that the city should find out by experiment just what can be done by mechanical methods, especially as the area of land required by these latter types is very small compared to that required by slow sand. If mechanical filtration proved effectual, it would mean that an unlimited quantity of water could be treated on the Island, whereas, by slow sand methods, the quantity is, of course, limited to something like about two or three millions per acre. The successful treatment of Ontario Lake waters on the Island would probably justify the city in deferring the Scarboro' scheme to a much later date than at present appears.

I hold no brief for mechanical filtration as against slow sand. But it does appear now that the hypochlorite treatment is becoming universally an adjunct to either process, that the rapid methods may prove all that is required.

Further, there is no doubt but that mechanical methods have been greatly improved of late years, and that splendid results, comparable in every way with slow sand, are being obtained.

With reference to the question of operating cost, it may be taken that when the amount of coagulant required (if sulphate of alumina) is not more than one grain to the gallon that the total capitalized cost of mechanical filtration works out at a somewhat less figure than slow sand. For example, a ten million gallons per day capacity plant for each type would run about as follows:

Slow Sand Filtration.

Cost of installation, about	$200,000
Cost per annum for operating, sand washing and upkeep at $3.50 per 1,000,000 gallons per day capitalized at 5 per cent.	255,500
Total capitalized cost	$455,500

Mechanical Filtration.

Cost of installation	$100,000
Cost per annum of coagulants at 1 grain per gallon, labor, washing, etc., $4 per 1,000,000 gallons per day, capitalized at 5 per cent.	292,000
Total capitalized cost	$392,000

Balance in favor of mechanical filtration on above basis is, therefore, $63,500.

I may say it is very difficult to compare costs of either type, as one almost requires that both types be working alongside one another, dealing with the same class of water under the same conditions.

I think you are about the mark when you mention the requirement of half a grain to the gallon of coagulant for Toronto water. Of course, this would make the total capitalized cost even more favorable for mechanical. A half grain to the gallon would cost in Toronto about $1.25 per each 1,000,000 gallons of water treated.

Yours faithfully,
T. AIRD MURRAY.

TORONTO'S WATER FILTRATION PROJECT.

The problem of whether the slow sand filtration or rapid mechanical filtration provides the most efficient system for Toronto's water supply is before that city.

Under the advice of Mr. Allen Hazen, supported by Dr. Amyot, of the Provincial Board of Health, Toronto has completed a slow sand filter plant which evidently requires expansion. Further, under the advice of Mr. Allen Hazen and, we believe, again supported by the Provincial Board of Health, the city Works Commissioner advises the city to duplicate the slow sand filter plant already constructed.

Ald. Yeomans, of the Toronto city council, has taken up with no little enthusiasm the cause of the rapid mechanical system as against the proposed duplication of the present slow sand method.

Mr. Allen Hazen, as a sort of reply to Ald. Yeomans, again reiterates his conviction that conditions at Toronto are more favorable to the slow sand methods than to the rapid methods.

The Canadian Engineer has felt that it is due to its readers that some expression of opinion in this matter be made. We have looked into the matter for ourselves, with the result that we are forced to the conclusion that there is evidence that slow sand filtration is not suited to Toronto water supply, and that there is no evidence before the city that rapid mechanical filtration is unsuitable.

On page 13 of the Report of the Board of Commissioners, Toronto Water Works, 1912, the following paragraph occurs: "This board has concluded that a mechanical filtration plant will meet the requirements at Scarboro', and will cost less than a slow sand filtration plant similar to that on the Island." On page 15 the estimate of cost is given at $653,400 for a 60-million gallon per day plant. What we wish to know is: If such a plant is considered suitable at Scarboro', then why not suitable at the Island?

Capacity of Present Slow Sand Plant, Toronto Island.

Twelve filters, each having a filtering area of about four-fifths of an acre, with a rated capacity of 32,000,000 Imperial gallons per 24 hours, is a rate of 3.3 million gallons to the acre when all are in commission.

As one filter at least should be out of commission for cleaning and only eleven filters in use, the capacity is increased to 3.6 million gallons to the acre.

The maximum capacity is stated as being 48,000,000 gallons per 24 hours, or at the rate of 5 million gallons to the acre when twelve beds are in commission, or 5.4 million gallons to the acre when eleven beds are in operation.

Capacities Elsewhere.

	Average (acres.)	Average daily consumption.
United States	17.13	26.87
British Columbia	.82	1.80
Holland	22.75	31.48
Great Britain	161.80	362.73
Germany	106.22	117.13
Other European countries	34.74	88.84
Total	343.64	648.85

Average per acre 1.8 million gallons.

From this it would seem that the maximum capacity should not exceed 3.6 million gallons per acre by allowing double the capacity of the average rate as practised throughout the world.

Most of these results are with clear waters which have been impounded and settled before filtration, so that the clear water of Lake Ontario comes under the same classification.

Efficiency of Present Plant.

To analyze the efficiency of the present filtration plant let us review its results from June to October (without the use of chlorine). This should be a fair trial, as the filters started up in the early part of January last.

The following chart prepared by Alderman Yeomans is made up from bacteria counts supplied to him by the medical officer of health, and shows graphically the efficiencies.

In the first run we find an average bacterial efficiency of 86.1 per cent. in 26 days, while in the latter the actual efficiency for 10 days out of a 35-day period there is an average of 204.10 per cent. worse than the raw water.

All authorities are unanimous in their statements that well operated filters should give an efficiency of about 98 per cent. where the raw water count is not too low, but at all times should give continuity of results from day to day.

Clearly viewed in the light of these efficiencies, Toronto's plant is a failure. Why? Briefly the causes may be put down as follows:

(1) Type of filter unsuitable.
(2) Design of filter faulty.
(3) Faulty construction.
(4) Faulty operation.
(5) Too high rate relative to capacity.

Type of Filter.—Before considering the type of filter the quality of the raw water must be considered, and its relation to the principles of filtration.

Dr. Frankland, one of the greatest authorities on the action of filters, gives the results of the investigations of Piefke, the resident engineer at Berlin waterworks, in which he fully concurs, which determine that the slimy coating on the surface of the filter sand is the main cause of high efficiency rates.

"In a small experimental filter constructed by Piefke with **sterilized waterworks sand,** and set to work in the usual way, it was found that the power of retaining microbes was nil, that in fact more organisms were often found in the filtrate than in the unfiltered water, multiplication having taken place during passage through the filter. These experiments with sterilized sand **demonstrate that it is the slime deposit on the sand which constitutes the real filtering material in the waterworks filter.**"

Bearing this principle in mind, we must consider all forms of filtration. For large waterworks systems these can be resolved into:

Slow sand filters.
Gravity mechanical filters.
Pressure mechanical filters.

In the first the slime is formed naturally, while in the two latter it is formed artificially by the precipitation of alum in various forms with the action of the lime in the water.

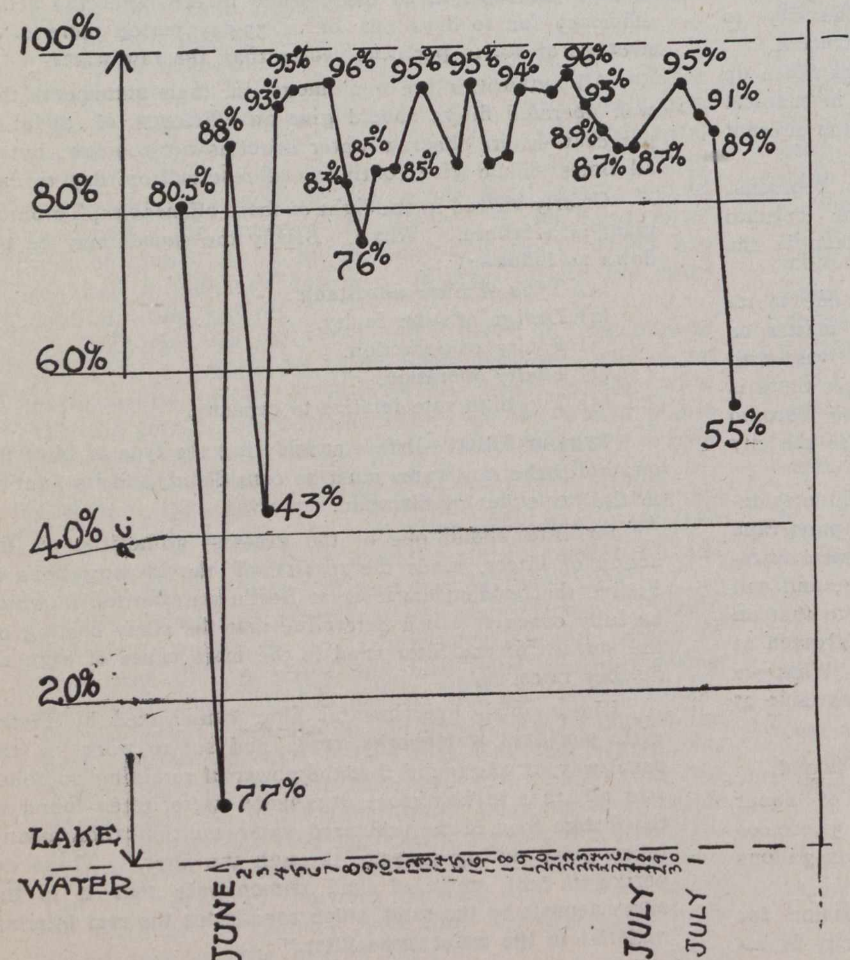
The first depends on the natural power of the water to form the film, while under the latter it is controlled.

If Lake Ontario water is so clear as to allow of the high rate of filtration which is being used, then it is too clear to form an efficient and strong film deposit, so that **probably the mechanical filter in this respect will be found more efficient.**

Of the two forms of mechanical filters the gravity filter is most successful in America, while in Britain the pressure filter holds first place. Both are found to give high percentages of efficiency, and to give them continuously.

Design of Filter Faulty.—In this respect an investigation was held, in which Judge Winchester presided. His summing up after all evidence was taken was that the design was all that could be desired, and this must be accepted with the mention that all filters should be designed so that they are absolutely watertight, according to the findings of the leading specialists and commissions. That there are leaks in Toronto's filtration plant has been established, and admitted by Engineer Hazen and his superintendent, Mr. Longley.

Faulty Construction.—In this respect Judge Winchester has decided that contractors have fulfilled the requirements of the specifications drawn up by Engineer Hazen, therefore, the question of leakages should rest with the question of design.



Graphic Diagram Showing Efficiency of the Toronto Slow Sand Filters from June 1st to July 5th, 1912.

Faulty Operation.—The filters having been operated to the satisfaction of Engineer Hazen's representative, under his supervision, any inefficiency due to their operation should rest with Mr. Hazen, who, according to the statements made from time to time in the daily press, authorized by him, is fully satisfied.

Too High Rate Being Used.—Commissioner Harris, Engineer Hazen, and Mr. Longley have repeatedly stated that the filters are being operated at too high a rate, so that they cannot be expected to give efficiency.

The responsibility for this rests with Mr. Hazen for designing and having constructed a filtration plant which will not give the efficiency required, even if such were done at the request of the council.

Surely an engineer should not hand over any plant to a municipality which he knows will not do the work required of it.

Present Position.—The present position, therefore, appears to be that either the design of the filter is faulty or its capacity is too small, both of which faults the designer has been paid a large sum of money to prevent. **In view of this, we do not think Mr. Hazen ought to be entrusted with the design of another filter until the efficiency of the present plant is placed beyond question, or mechanical filtration experimented with.**

It appears to us that what is required now for an extension of the present waterworks system is a filtration plant which we know will give efficient results. One that can be erected speedily to bring the present plant up to the capacity required, and one which will rectify the deficiency in filming due to the character of Lake Ontario water, by the addition of mechanical means under engineering control, not subject to the vagaries of the raw water.

From this review it appears that mechanical filters are worthy of independent investigation, and the reasons why they have not been so considered lead to the conclusion that Mr. Hazen's advice has been solely relied on.

Mechanical Filters Have Not Been Fully Considered.

Commissioner Harris is a good business man, but not an engineer, and as such has strictly relied on the advice of Mr. Hazen. Surely it is up to Commissioner Harris to have this advice from some other person than the engineer responsible for the first plant.

Mr. Hazen has been building slow sand filters for a great many years, and may be prejudiced in their favor, and may be loath to consider other methods which have arisen in more modern practice. He has reported that operating costs of mechanical filters are too high and they are not suitable for Lake Ontario waters.

A comparison of the two systems is therefore advisable, the principal points of which are as follows:

(1) Suitability.
(2) Efficiency.
(3) Operating costs.
(4) Methods of washing.
(5) Capital investment.
(6) Time for construction.
(7) Space required.
(8) Need for disinfectant.
(9) Taste, color, hardness.
(10) Operating supervision.
(11) Chances of pollution.

Suitability.—The question of suitability is chiefly determined by the raw water, and it is very doubtful if Lake Ontario water has the qualities necessary for the formation of the film which is the chief medium in obtaining efficiency, it would appear that an artificial means would remedy this defect to advantage, provided no trace of the reagent employed is left in the water after passing through the filter. Mechanical filter manufacturers have stated that they are prepared to give a guarantee that this can be effected.

Efficiency.—The efficiencies of mechanical filters (without chlorine) are invariably as high as need be desired, a few of them may be given as under:

United States, Atlanta	98.4%
England, Shrewsbury	98.8%

United States, Loraine	98 %
United States, Harrisburg	99.1%
England, Buxton	99.6%
United States, Louisville	96.7%
England, Banbury	99.4%

Numerous other results give in every case high efficiencies, as high as slow sand filters are showing in similar circumstances.

Operating Costs.—The chief cost of operation is the coagulant or reagent in the case of mechanical filters, and of cleaning in slow sand filters. For Lake Ontario waters an average of ½ grain of alum is required or 71 lbs. per million gallons treated, which at current market prices amounts to $1.06.

The average amount of sand to be washed on the American continent is 3.8 cubic yards per million gallons at 32 cents a cubic yard or $1.21 per million gallons. This does not include the cost of scraping, which might very well be balanced by the cost of washing sand by mechanical methods. It would seem, therefore, that there is a slight advantage on the side of mechanical filters in regard to operating cost.

Methods of Washing.—With slow sand filters the sand is scraped off by human agency, taken out and washed. With mechanical means all sand is washed mechanically in enclosed vessels which avoid any chance of contamination by those working on the plant.

Capital Investment.—Slow sand filters are a permanent investment and cannot be removed. The true mechanical filter is made up in units which can be moved to any desired location, according to the changes which make it necessary. In rapidly growing cities where the requirements and the policy of the future cannot be determined. this is a very desirable feature. The cost of the present Toronto plant is at the rate of $23,400 per million gallons treated, while rapid filtration is about $10,000 per million gallons. (See commissioners' report).

Time for Construction.—A duplication of the present slow sand filter will take about three years to complete. With mechanical filters the present shortage can be made good in eight months at the most, and other units can be added as they are required at short notice, so that shortages can be made up in a few months at most.

Space Required.—The space required for slow sand filters for a duplicate plant in Toronto will be above eleven acres. With purely mechanical filters less than one acre is required.

Need for Disinfectant.—With the present slow sand filtration plant it is absolutely necessary to have a disinfectant to prevent danger. With mechanical filters a purification of 97 per cent. can be obtained without the use of disinfectants, but a small amount would render the water practically sterile.

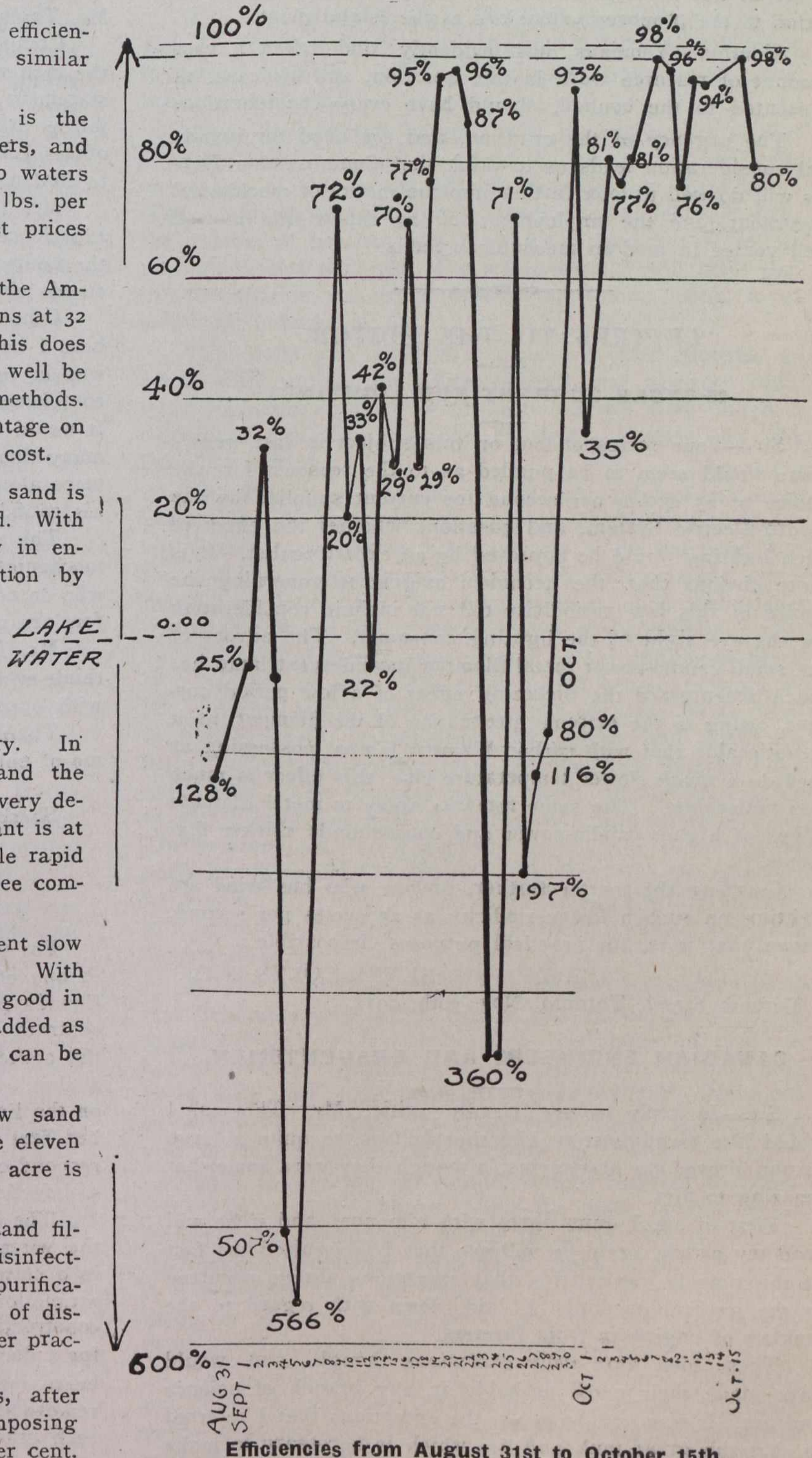
Taste, Color, Hardness.—With slow sand filters, after the filters have been idle there is a chance of decomposing vegetation giving a taste to the water. About 10 per cent. of color is removed, and there is no alteration to the hardness of the water.

With mechanical filters there is no taste, 90 per cent. of color being removed, while the water is increased about 1 degree in hardness.

Operating Supervision,—With slow sand filters skilled operators are required to see that the head is regulated to the flow, and to regulate supply to the filters to prevent their becoming inefficient by allowing too high a rate of filtration to pass.

With mechanical filters the engineers at the pumping station can secure the desired results.

Chance of Pollution.—Slow sand filters, being submerged, should there be any leakage from outside sources, there is serious danger which is not detected till after the water has been examined.



Efficiencies from August 31st to October 15th.

(Percentages for charts obtained from figures supplied by the Medical Officer of Health)

With mechanical filters every joint, pipe and filter is above ground, where any leak can be detected at once, and there is no chance of the outside water leaking in.

The former occupies a large area of foundation and runs considerable risk of settling, which makes the danger from cracking on insecure foundations very great, while the latter is not subject to this without immediate remedy.

There only remains, then, the fact of the pumping to the filters which would be greater in the case of mechanical filters, owing to their requiring a greater head of water to operate with, but this does not amount to more than fifty cents per million gallons, as per Mr. Hazen.

We have gone carefully into these facts and think that recommendation of the board of water experts for mechanical filters at Scarborough should be carefully considered in relation to the proposed extensions at the Island plant.

Alderman Yeomans has evidently undertaken a vast amount of research work in this question, and his case, as presented to the council, should have every consideration.

The urgency of the question, and the need for impartial consideration leads us to think that Commissioner Harris will do well to look further into the merits of mechanical treatment, and the employment of an expert who is well well versed in modern mechanical plants.

LETTERS TO THE EDITOR.

25-CYCLE CURRENT FOR LIGHTING.

Sir,—Your correspondent on this subject in last week's issue would seem to be puzzled as to the reasons for the choice of 25 cycles per second for current supplied by the Hydro-Electric System, and questions whether the effect of such lighting would be approved by an expert oculist. It is quite obvious that the technical exigencies governing the choice of this low periodicity did not include consideration for the eye sight of the lighting consumer. The advent of the small candle-power metal filament incandescent lamp has much accentuated the flickering effect of a low period current, owing to the extreme attenuation of the filament, as it is noticeable that with carbon filament lamps, possessing as they do a much slower temperature rise, this effect is much less noticeable. The same remarks apply to metal filament lamps of higher candle-power and consequently thicker filaments.

Carrying the matter further, anyone who has tried arc lighting on such a low periodicity as 25 cycles per second, knows that it is, for practical purposes, impossible.

HENRY COLES, E.E.

2 Toronto Street, Toronto, Nov. 30th, 1912.

CANADIAN ENGINEERS AND DRAUGHTSMEN.

Sir,—In reply to my friendly critic, Mr. Thomas, I would like to suggest to him that he has, to quite a large extent, proved my statements, although they were somewhat amazing to him.

First of all, I quite agree with him now, and if he will read my article again he will see that I recognized the fact at the time it was written that exceptions always occurred to the general principle I laid down with regard to the making of engineers from farmers.

These men were truly exceptions though, and would have made their mark probably in any branch of science and art. It was not, however, the exceptions that I referred to, but the great rank and file which is necessary to make up a mighty army.

I would ask Mr. Thomas, however, what is the natural tendency with, say, perhaps nineteen sons out of twenty? Is it not to follow in the steps of their fathers?

For myself, I am an exception to this, in a way, as my father was connected with the clerical staff of a railway system in the Old Country. Both my grandfathers, however, were workers in iron. Unfortunately, I cannot trace my pedigree back any farther than this, so that it is impossible for me to say how long the iron was in the blood. Now, I originally followed my father's footsteps when I started work, but found the work so uncongenial that at the end of about three years I gave it up and entered into my present profession. So, perhaps, in face of this evidence, it was a case of an exception in my father and not myself.

I am afraid I do not agree with the second paragraph of Mr. Thomas' letter.

Competition is keen everywhere, even in Canada, for the man who is looking up to the top of the tree. Also the statement that no one without shop experience could get a job as draughtsman in England is incorrect, as most of the offices I worked in it was the exception rather than the rule to find men with practical training.

Mr. Thomas must certainly have had rather an unlucky experience with his employers, I am afraid. I grant that the hours are longer, but I believe the province of Quebec stands alone in this from what I have heard.

Otherwise, I must confess that since I have been over here I have been treated more like a human being than I was in the Old Country, and as for the mutual trust and confidence, I think one has to merit that before you get it. It would not be reasonable for a boss, having sunk a good many thousands of dollars into his business, to let any man come along and do as he likes until he has satisfied himself his confidence is not misplaced.

The men in England who earn 35 shillings a week at mechanical engineering designing are the very sort of men who do not worry about theoretical considerations, and therefore are paid according to the service they give.

Mr. Thomas was certainly preparing for a storm, and I think every draughtsman would simply shout himself hoarse with opposition to his amazing statement.

Thanking Mr. Thomas for the opportunity he has given me of enlarging on this subject.

F. TISSINGTON.

Sherbrooke, Que., December 1st, 1912.

THE WORK OF RATS.

For many weeks the private telephone system installed in one of the largest and best-equipped printing offices in Canada has not been giving the service called for by the contract, and the electrical contractors, in accordance with the agreement, have searched for many days without even a clue. Outside of the fact that there was a short circuit on the line from the battery case, nothing could be secured, but first one instrument and then another would fail to respond or cross with another, or would work with complete satisfaction for a day or two, then drop off.

The cable was of the standard construction, wherein all the wires, insulated with cotton, wax-covered, are enclosed in a cotton covering, also waxed; this covering was, in the estimation of rodents, entirely suitable for use in home construction, and they removed the covering from every wire for a distance of about fourteen inches, and the bronze wire bears many indentations of their teeth. In their effort to remove the covering many of the wires were twisted around each other, and this, of course, was responsible for the ineffective operation of the system.

This illustration at once suggests the question, "Are many of the fires now laid to the cause of "defective electric lighting" due to these rodents removing the insulation from electric light wires in the same manner?"

Application will be made to the Dominion parliament for the incorporation of a company to carry on the business of fire insurance in all its branches, under the name of the Great West Fire Insurance Company. Messrs. Elwood, Embury, Scott and Graham, Regina, are solicitors for the applicants.

RECONSTRUCTION OF AN OLD RETORT HOUSE.*

By Mr. Howard E. Mann.

Prior to the year 1909 coal gas was manufactured in three retort houses at the Elm Station of the "Montreal Light, Heat and Power Company." These retort houses were referred to as No. 1, No. 2, and No. 3. No. 1 retort house was built in 1871. The building was of stone, 225 feet 6 inches long by 65 feet 7 inches wide, and 27 feet to eaves of roof. There were originally 19 direct fired benches containing seven 15 inches by 21 inches by 20 feet, through oval retorts. Recuperators were later added, and a pit excavated extending the full length of house on furnace side of benches. This pit was for clinkering purposes and the inspecting of recuperators. The recuperators were shallow, and would not be considered more than quarter-depth. The mouthpieces were old type with luted lids. Ascension pipes were 6 feet in diameter. The hydraulic mains were of cast-iron, with tar seal and overflow.

When first operated all the work of the recharging of coal and the discharging of coke was done by hand.

In 1895 "Bronder" charging and discharging machines were installed; also, an inclined cable system, with side-dumping cars, for the handling of coke from retorts to coke dump.

This installation was superseded in 1905 by DeBrouwer projector and ram. The house was also equipped with DeBrouwer coke conveyer, which extended the full length of retort house and up an incline to an outside radial coke conveyer. This radial coke conveyer was intended to cover a large area for stocking purposes. Owing, however, to design of tower, which supported far end of conveyer, it was impossible to radiate same without first moving 2,000 or 3,000 tons of coke which had fallen around tower, completely burying same from ground level to conveyer support.

No. 2 retort house was built in 1888. The building was of stone, 225 feet 5 inches long, 69 feet 6 inches wide and 26 feet 5 inches to eaves of roof. The original bench installation consisted of 17 half-depth benches of eights, with oval retorts 15 by 24 by 20-foot, through. As with No. 1 retort house, the transition from hand labor to machine operation was the same. Mouthpieces were of the self-sealing type. Stand pipes, 6 inches diameter, hydraulic mains of steel. Tar overflows and tar seals were originally used in this house, when a change later on was made to liquor seals. A clinkering pit, the same as in No. 1 retort house, was used for access to furnaces and recuperators. A DeBrouwer coke conveyer delivered coke into an inclined conveyer adjoining No. 3 retort house. A wooden coal storage bin was erected between No. 1 and No. 2 retort houses, and delivered coal to hoppers of DeBrouwer projectors.

No. 3 retort house was built in 1907. The building was 173 feet 9 inches long by 68 feet 4 inches wide, and 40 feet 6 inches to eaves of roof. This building was of first-class construction, being of steel, brick and concrete. The steel roof had a covering of cinder concrete, water-proofed with plastic asphalt.

The bench installation consisted of 9 full-depth, recuperative benches, of elevens, with D retorts, 15 inches by 25 inches by 20 feet, through. The mouthpiece, hydraulic mains, tar and gas mains were of English design. The coal bunkers were continuous and extended the full length of setting. Two 50-ton per hour bucket-elevators delivered coal from ground floor to 20-inch coal conveyer-belt, located over top of bunkers. A DeBrouwer projector and ram were installed for charging and discharging retorts, and a DeBrouwer coke conveyer delivered coke into an incline conveyer, which, in turn, delivered coke to rotary screen and small storage bin.

This type of retort house had been decided upon as the unit for future extensions, arrangements having been made to extend building and install 9, and possibly 18 more, benches of elevens.

These three retort houses, with the equipment of DeBrouwer charging and discharging machinery and coke conveyers, would be considered an extensive installation. The combined length of retort houses was 624 feet 8 inches; the number of benches was 47; the total number of 20-foot through retorts was 368. For comparison I will state that this installation was equal considering retorts alone, to 92 stop-back benches of 8's.

The daily gas production from all three houses, on 6-hour work, during the winter of 1908, was 3,000,000 cubic feet. In justice to this low production I will state that coal carbonized was not from the Pittsburg district, but was Canadian mined coal.

Owing to the increased yearly gas production, made possible by the expansion and growth of the city of Montreal, it became apparent to the officials of the company that the problem of gas manufacture with the existing retort house installation was becoming serious. The reconstruction of No. 1 and No. 2 retort houses was considered; also an extension of No. 3 retort house by an additional block of 9 benches of 11's. The condition of bench ironwork in No. 1 retort house would not permit of same being used in reconstruction, mouthpieces, standpipes and hydraulic mains being held together more by good luck than by bolts and rivets. The furnaces being small, it was impossible to obtain sufficient heat to carbonize a full retort of coal. The recuperators were practically useless, the secondary air ports in some benches entering the furnace below the furnace arch. In justice to the management I will state that this arrangement of secondary air under furnace arch was an American idea.

All of the retorts in the 19 benches were so badly cracked and punctured with holes that it was impossible to patch same further. In fact, everything pertaining to these 19 benches was practically worn out. When you consider that the greater part of the material, outside of retorts, had been in service for 38 years, we realize that what was left could only be considered as nothing more than junk.

After considering the capital outlay required to reconstruct No. 1 retort house, using the same arches, small furnaces and recuperators, and at the same time considering the tonnage carbonized, with small make of gas per man, it was decided that no reduction in cost of gas could be made, or increase in gas production obtained, unless full-depth benches and larger retorts were installed.

The condition of benches in No. 2 retort house was practically the same as benches in No. 1 house. Hydraulic mains were not only warped and twisted out of shape, but were also spattered full of holes. The bench ironwork was in a similar condition to that existing in No. 1 retort house. Retorts, furnace linings, and recuperators would require resetting inside of 12 months. Owing to condition of hydraulic mains a heavy seal was required to insure against air being drawn in when charging. No arrangement for lowering of seal after charging was used with result that make of gas per ton of coal was affected.

The clinkering pits in No. 1 and No. 2 retort houses were places that will always live in the memory of the men who worked there. With no ventilation, except from the inclined entrance at one end of the house, with the heat from furnaces reinforced by the burning of ½-inch gas pipe

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* Paper read before joint meeting, Canada-Michigan Gas Association, Toronto, September, 1912.

torches in front of every other furnace, with occasional backing up of sewers and flooding of pits, the clinkering of furnaces and wheeling out of ashes during winter months constituted a job that polite language is totally inadequate to describe.

The reconstruction of No. 2 retort house, using a modern design of half-depth benches, and utilizing all bench ironwork that could be recovered, was seriously considered. As No. 3 retort house adjoined No. 2 retort house we would have one house operating from the ground floor and one house operating from a stage floor. Additional coal-handling equipment would be required, and future coke storage (which we had in view) would not be available. The enlarging of clinkering pits would be expensive and as costly as a steel and concrete stage floor. There were too many factors against the reconstruction of No. 2 retort house with half-depth benches. Increased production of gas was absolutely necessary, the make of gas per man would have to be greatly increased, and the cost of gas reduced to warrant the capital outlay. We could not see wherein the perpetuation of half-depth benches would meet above requirements. We, therefore, decided upon another scheme of reconstruction, which has worked out to our entire satisfaction, re-production of gas, make per man, and reduction in cost of manufacture. Before dealing with the reconstruction of No. 2 retort house, a description of No. 3 retort house and a statement as to condition of benches in May, 1909, I believe would be interesting.

As previously stated, No. 3 retort house was adapted as the unit for future extensions. The benches were guaranteed for 2,000,000 cubic feet of gas per 24 hours, on 6-hour work. Each bench contained 11 D-retorts, set vertically in 3 tiers, 4 on each side and 3 in the centre. The centre, bottom retort, or bull's eye directly over furnace, was left out, and one furnace on discharging side of bench heated the setting.

This house was completed, and benches charged, July 15th, 1908. After operating a short time settlement was noticed in retorts over furnace, and this settlement became so great that charges could not be pushed out by ram. It was, therefore, decided to let down the collapsed benches and reconstruct the settings. A change in design was adopted with a view to overcoming this settlement and rupture of retorts. This reconstruction was not satisfactory. The retorts again collapsed, and, in some cases, closed up so completely that it was impossible to get a clinker bar into a retort. Gas could not be produced in this house without further reconstruction of settings.

As it had been decided not to rebuild benches in No. 1 retort house, we were left with only No. 2 retort house for the production of coal gas. With an increased gas consumption of over 10 per cent., the problem of supplying the consumers was becoming serious. Fortunately, the company had a water gas reserve of 2½ million cubic feet per day; but this production was not equal to the combined make of Nos. 1 and 3 retort houses. It was apparent that our only recourse was to increase the capacity of the water gas machines. Altering the time of blow-and-run, increasing steam openings and measuring steam and air used, increased the capacity of water gas machines 100 per cent. Mr. Haug's paper at last year's Quebec meeting dealt with this problem. The increased capacity of the water gas machines permitted us to put No. 1 retort house out of commission.

The reconstruction of No. 3 retort house was, then, our first problem. The two failures of the bench contractor convinced the management of the company that radical changes were required to insure stability of setting. We, therefore, decided to make up our own design and reconstruct with our gas works' staff. A bench of 11's is not a standard design, and careful perusal of gas literature failed to give us a design we considered suitable. A block setting would require too much time in waiting for material. Fortunately, we had in stores several hundred thousand Scotch firebrick, Welsh silica brick, 12-inch brick soaps, splits and arch bricks. It was decided to use these bricks in resetting the benches, as a block setting was out of the question when time was considered.

A design that we believed would overcome collapse and settlement in block setting was adopted. The furnace arch was torn out, carried higher up into combustion chamber, and rebuilt of silica brick. Furnace was widened from arch to grate bars, and relined. The combustion chamber was built of silica brick. The supporting walls for retorts were made of a 9-inch silica brick, and Scotch firebrick. The firebricks were used between side retorts and division walls of benches. The centre of supporting walls, from combustion chamber to main arch, was silica brick. These supporting walls were 9 inches apart, and carried up to main arch where provision was made for expansion. Retorts over combustion chamber were protected with silica brick in a similar way as shield tile are used in block settings. The recuperators, having given no serious trouble, were not disturbed. We have since redesigned and rebuilt recuperators, for we found, after a year's operation, tiles so badly ruptured, due to structural weakness, that short-circuiting of air seriously affected the heat of bench.

After the resetting of benches was completed we had, with the exception of retorts and recuperators, a bench built entirely of 9-inch bricks. This design was a departure from standard block construction, and we were told by bench builders that all manneer of trouble would be experienced.

No. 3 retort house was charged September, 1909, and, with the exception of time consumed in renewing recuperators, has been in continuous operation for 3 years. All of the benches will have a life of 4 years, and we expect to continue some benches on to the fifth year. Up to date we have experienced no settlement of retorts or settings. The retorts are level and true, the division walls and combustion chamber are as sound as when first constructed, and, with the exception of minor patching and repairs, we have had no further trouble or expense with this stack of elevens.

After operating the brick setting for a few months we were so well pleased with the condition of retorts, combustion chamber, supporting walls, etc., that we decided to adopt this type of construction for all future extensions. In the spring of 1910, the benches in No. 2 retort house were in condition for resetting. Having decided against the reconstruction of this house with half-depth benches, our only alternative was extension of No. 3 house as originally contemplated, or complete reconstruction of No. 2 house. The capital outlay required for the extension of No. 3 house we considered too high for a 2,000,000 coal gas unit. The walls and roof of No. 2 retort house were sound, but height of walls to eaves would not permit installation of stage floor benches. Floor space was ample for 18 benches of 8's, which would produce 2,500,000 cubic feet of gas per day on 8-hour work, or 3,000,000 cubic feet on 6-hour work.

As No. 2 retort house adjoined No. 3 house the reconstruction of same to make one continuous building was cheaper than proposed extension to No. 3 house. Yard space for present storage of coke and future storage of coal, would be reduced if extension to No. 3 house was adopted. We, therefore, decided upon the reconstruction of No. 2 house and the installation of 18 full-depth benches of eights.

The walls of building were 26 feet 5 inches to eaves of roof. As roofs to both houses were to be continuous, it was necessary to increase height of walls 14 feet 1 inch. The old roof was first cut in three sections; one section at a time was raised by chain-blocks attached to gin poles.

Brick walls were built up on old stone walls to a height level with wall plate of No. 3 house. As walls were completed, roof sections were lowered into position, riveted together and connection made to roof over No. 3 house. The roof covering was made of a thin layer of concrete, waterproofed with plastic asphalt.

The bench installation for new house consisted of two stacks, each stack containing 9 benches of 8's.

The brick setting in No. 3 house having worked out satisfactorily, we decided to adopt brick construction entirely in the settings of eights. The material used in furnace arch, combustion chamber and supporting walls of retorts was the same as used in the setting of elevens, but a change in design of combustion chamber was necessary, owing to the centre row of retorts being left out. The retorts were of Glenboig material, D-shape, 16 inches by 26 inches by 20 feet, through, set in two vertical tiers of four. The combustion chamber was built directly over furnace arch, and extended the full length of setting. The secondary air entered combustion chamber through flues opposite each nostril hole in furnace arch. Silica shield tile protected sides and bottom of retorts next combustion chamber. The furnace, located on discharging sides of bench, was of ample size to evenly heat the setting. Special attention was given to design of recuperators to minimize short circuiting of secondary air. The flue gas was led from recuperators into a main flue 4 feet wide by 4 feet 6 inches high, which extended the full length of setting and connected to chimneys at each end of house. The 4½-inch firebrick bottom of flue was laid directly on top of foundation. A 4-inch wall or mid-feather was built in centre of flue and extended the full length of same.

The stage floor was level with floor in No. 3 house, the charging side being made up of steel beams with checkered steel and cast-iron floor plates. The discharging side floor was made up of steel beams filled in with reinforced concrete. Mouthpieces on charging side of bench were 20 inches deep, and 7 inches on discharging side. Tar aprons were attached to mouthpieces with the exception of bottom row. The 8-inch ascension pipes and hydraulic mains were on charging side only. The discharging side was free from ascension pipes, hydraulic mains, etc. As gas was taken from retorts on charging side, the mouthpieces on discharging side were at all times free from tar. We were, therefore, not troubled with tarry and spongy coke, which is generally formed in and around the mouthpieces. Another advantage gained was reduction in cost of hydraulic main equipment and saving in pipe men on discharging side of house. Stopper men were dispensed with by allowing spongy coke pushed over into discharging mouthpiece to remain as a stopper for the charge from projector. This spongy coke was converted into dry coke during the next period of carbonization.

The coke was delivered into a DeBrouwer conveyer, which, in turn, delivered coke into incline conveyer connected with No. 3 retort house. Each bench had an individual hydraulic main. To each hydraulic main was attached a 10 by 10 weir valve for outlet of gas and regulating depth of seal. This weir valve was connected to 24-inch foul gas main, which extended the full length of setting and joined a header main connecting to 30-inch foul gas main on wall of building. At junction of header main two 16-inch retort house goverenors with by-passes were installed, and two clean-out pockets for removal of heavy tar were attached to each hydraulic main. A 4-inch tar outlet at bottom of hydraulic main connected with 10-inch tar main, which extended the full length of setting, and delivered tar and liquor into tar tower. A weir valve at tar tower was also used to regulate depth of seal in hydraulic mains. The liquor overflowing from tower passed into tar and liquor separator in cellar of retort house. Liquor was pumped from receiving tank connected to separator back into hydraulic mains. The accumulated tar in tower was drawn off every hour and flowed into tar well. Continuous coal bunkers, of 24 hours' capacity, extended the full length of stack on the charging side of benches.

The results obtained from 8-hour work in No. 3 retort house were so satisfactory that we decided to adopt 8 hours as the time of carbonization for all charges of both houses.

With the DeBrouwer projector we were able to charge the retorts full, thereby reducing the area of retort exposed to the gas. The time contact of gas with crown of retort was reduced to a minimum, which resulted in eliminating stoppages of ascension pipes and pitched hydraulic mains.

The coke (produced from Westmoreland slack coal) was very large and hard, closely resembling oven coke. This was due to increasing time of carbonization and full charges in retorts. Coke handling equipment, consisting of crusher, screens, bins, skip hoist and belt conveyers, now being installed in No. 1 retort house building, will give us an overhead inclosed coke storage of 4,000 tons capacity.

The total cost of reconstructing No. 2 retort house, including alterations to building and complete retort installation, was approximately $140,000. The production of coal gas was increased from 3,000,000 cubic feet per day to 4,000,000 cubic feet per day on 8-hour work, or 5,000,000 cubic feet per day on 6-hour work. The work of reconstruction and the dismantling and abandonment of No. 1 retort house at the cost indicated, were amply justified by the resultant increased production of gas and reduction in cost per 1,000.

MERGER OF BRIDGE COMPANIES IN MONTREAL.

The latest merger spoken of here is that of the Dominion Bridge Company and the National Bridge Company. The expectation is that the Dominion Bridge Company will buy the National out, and that following this there may be an issue of the stock of the Dominion Company and that this may be listed on the local stock exchange where the public may buy and sell it as in the case of other stocks. There can be no doubt that Dominion Bridge would be one of the popular trading stocks as the company has been so well known for many years past and has been unusually progressive and successful.

The National Bridge Company has a capital of $1,000,000 common stock and a bond issue of $560,000 of 6% first mortgage, 40-year sinking fund bonds. The plant has only been in operation since July 1st, 1911, and a year after it had begun was turning out a total of 1,300 to 1,400 tons per month.

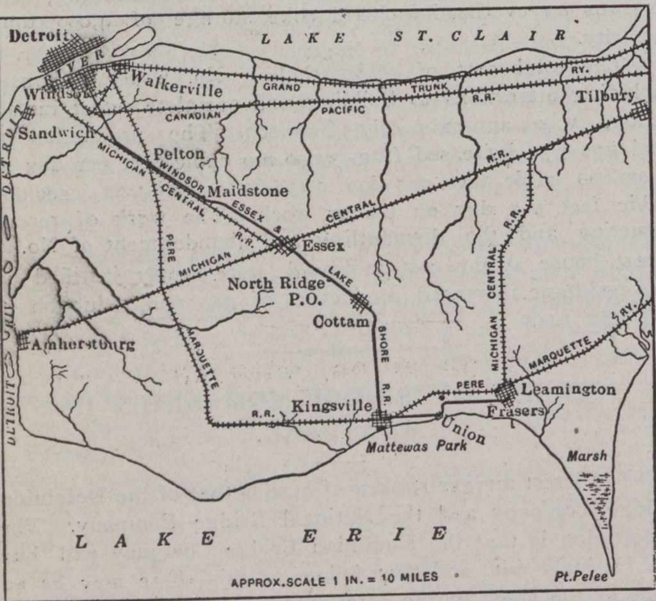
It is the owner of 350,000 feet of land and a plant at Longue Point, near the city, and although its plant is operating to full capacity it is quite unable to keep up with the orders which are coming in from all quarters. There are now orders in hand, it is claimed, to keep the plant going until well into next year.

Not the least remunerative of the assets of the company must be an option possessed on a block of 560,000 feet of land adjoining its own property. This option has till next April to run and land has been increasing at a very rapid rate in value in the vicinity mentioned.

It is stated that the Dominion Bridge Company will guarantee the interest on the National Company bonds and give one of its shares for four of the National shares. The directors of the National are Messrs. J. N. Greenshields, K.C., president; William Lyall, W. G. M. Shepherd, Hon. R. Mackay and H. W. Beauclerc.

THE WINDSOR, ESSEX AND LAKE SHORE RAPID RAILWAY.

The Windsor, Essex & Lake Shore Rapid Railway is a single-track line extending from Windsor to Leamington in the province of Ontario, with a total trackage of 40 miles. The line has been operated since 1908 and has the distinction of being the first and only single-phase railway in Canada. A very full description of the line was given in a recent issue of the Electric Railway Journal; this abstract is prepared from that article. The operating conditions are simple, as may be judged from the fact that the country is of level character with the exception of a 5 per cent. grade near Kingsville. Twenty-six miles out of the 37 miles of route are on private right-of-way, but in spite of this there are few curves. The following paragraphs will present some figures on the maintenance cost of the electrical features of this road and also a description of the freight and passenger business development.



Routes of Windsor, Essex & Lake Shore Railway and Nearby Steam Railroads.

The line construction is of the catenary type with cross-span suspension in towns. The poles are 120 ft. apart on tangents and as close as 80 ft. on curves. The material is of Westinghouse standard type, consisting of a steel messenger wire with hangers spaced 10 ft. apart, No. 000 grooved trolley wire, wooden-arm steady strains at curves, etc. In general the line is anchored at every thirty poles. This catenary carries current from the power house to the substation at Madisone, 18 miles distant, at 6,600 volts, which voltage is also used for the trolley service throughout.

The maintenance records for 1908 and 1909 do not show the charges made specifically for the upkeep of the line and bonding, but for the following fiscal years ended June 30 the amounts spent were as follows: \$2,084.26 for the year 1910; \$1,650.79 for 1911; \$1,808.58 for 1912, a total of \$5,543.63, or an average of \$46.19 per mile per annum. Other figures by months were as follows: July, 1911, \$174.66; July, 1912, \$73.53; August, 1911, \$179.58, and August, 1912, \$145.53. These figures are not chargeable entirely to line and bonding account because the three linemen have plenty of time available for other work. The excellent behavior of the catenary construction will be best appreciated from the fact that in nearly five years of service only one or two wire breaks have occurred and it has been unnecessary to replace any material whatsoever. Most of the expenses charged were due to the installation of additional material such as strains at curves, hangers, switches, etc. Pantograph current collectors are used, and it is figured that the trolley wire is good for three to five years more. It is probable that the replaced line construction will consist of a copper catenary and a steel trolley wire. The snow-fighting equipment consists of an ordinary flat car which was fitted with nose plows at each end.

It has not been found necessary to make any track replacements or the like, but the roadway has been greatly improved by being reballasted with spoil from the company's gravel pits.

The generating equipment of the power house at Kingsville consists of two Goldie-Corliss cross-compound engines, operated at 125 r.p.m. and direct-connected to 500-kw., 25-cycle, 13,000-volt single-phase generators, which are furnished with 6,600-volt taps for the trolley line. These engines have required so few repairs that the total expense for five years' operation has been less than \$50. The repair expense to the generators would be covered by about \$100, the cost of four or five coil burn-outs.

Perhaps the most interesting feature of the station is the use of natural gas for the four 360-h.p. Canada water-tube boilers. Each boiler has seven Gwynne burners which have three cocks whereby the amount of fuel supplied to the boiler is regulated as easily as with a domestic gas stove. A slide valve at the end of each burner tube is manipulated to change the air mixture until a perfect blue flame is secured. The gas is obtained from the wells at 500-lb. pressure and is reduced to 8-oz. pressure at the boilers. Its fuel value is 11,000 b.t.u. per cubic foot. The boilers are operated at 140 lb. to 150 lb. steam pressure. The amount of attendance which these boilers need is so little that only one night man and one day man are required except for the occasional help of a cleaner from the engine room. In fact, the entire staff of the boiler station consists of but three day men and two night men. The use of natural gas as fuel has also proved an excellent thing from the maintenance standpoint because so far no replacement material has been required except a few bricks for the settings.

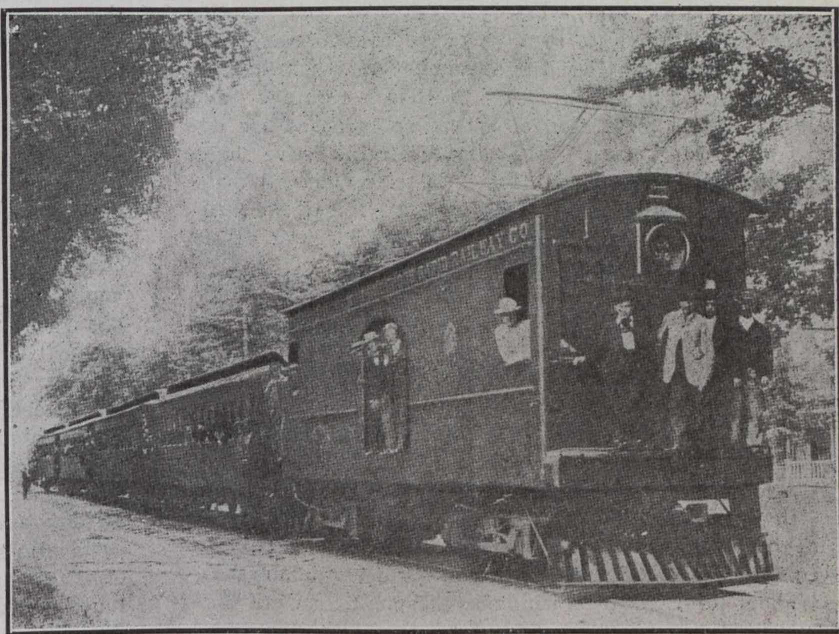
The original rolling stock consisted of five 55-ft. interurban type motor cars, four passenger trailers formerly used in elevated railway service, two baggage trailers and one electric locomotive. The passenger cars are each equipped with two 100-h.p. Westinghouse-132 straight single-phase motors, and the electric locomotive has four 100-h.p. motors of the same type. A similar equipment of four 100-h.p. motors has been furnished for the new combination express and locomotive car. The company also keeps four spare motors on hand. In general, the motors have always proved capable of meeting the conditions for which they were designed except that under excessive overloads they do not accelerate so quickly at a d.c. motor. The only trouble given by the original type was due to the breaking off of the thin leads at the commutator. The original coils were therefore replaced with coils with thicker tips, and no further trouble has been experienced. The company does all its coil winding and baking and also slots all commutators. The pantograph shoes are home made.

For the year ended June 30, 1911, the cost of maintaining the electrical equipment of the cars was \$6,793.47 and for the following fiscal year \$4,899.88. During the fiscal year ended June 30, 1911, the company operated 266,063 passenger miles and 80,903 freight and miscellaneous miles, making a total of 346,966 miles, and for the following year 273,380 passenger miles and 85,223 freight and miscellaneous miles, making a total of 358,603 miles. Approximately 2 per cent. of the passenger mileage included trailer service. In accordance with these figures the maintenance cost of electrical equipment of cars was \$19.57 per 1,000 miles for the year ended June 30, 1911, and $13.66 per 1,000 miles for the year ended June 30, 1912. It is believed that the cost will be appreciably less during the next few years, owing to the change in armature coils and because the cars have been thoroughly overhauled during the past few months. The company feels that it has every reason to be satisfied with the behavior of the car apparatus.

The company operates nine passenger trains a day each way between Windsor and Leamington, a distance of 36.6 miles, and one extra passenger train each way between Kingsville and Leamington, a distance of 8.7 miles. Two of these trains are limiteds except on Sundays, when all trains are locals. The local trains make the run from Windsor to Leamington in one hour and forty-five minutes and the limited trains in one hour and twenty-five minutes. The institution of limited train service increased the company's passenger business about 20 per cent.

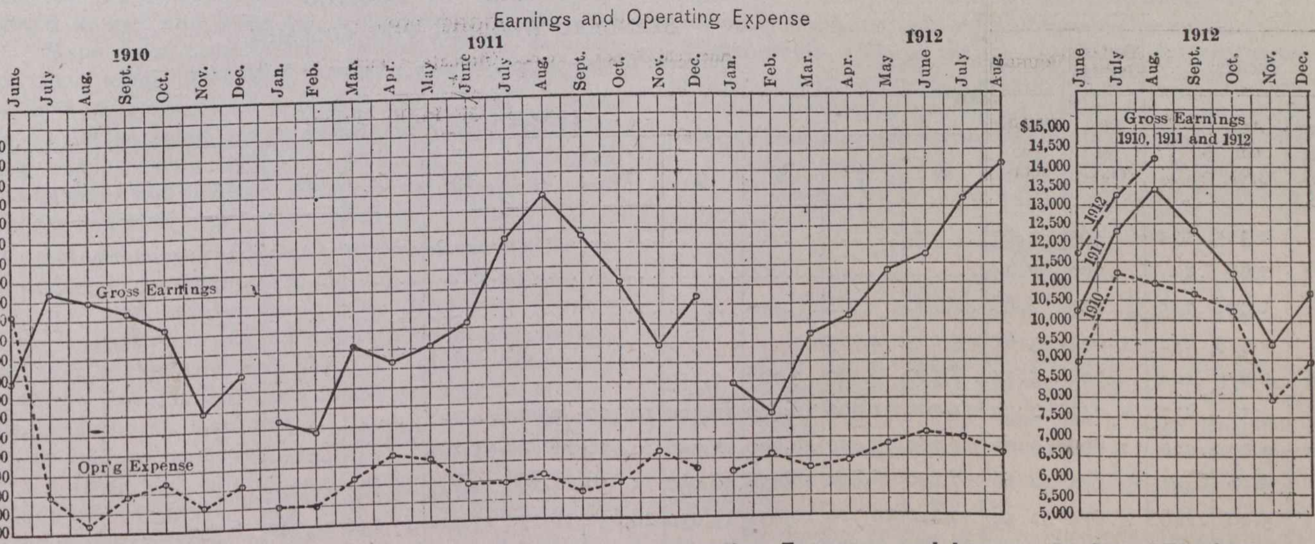
In addition the company operates each weekday two express and freight trains each way. These are scheduled to make the trip between Windsor and Leamington in two hours and ten minutes in one direction and one hour and fifty-five minutes in the opposite direction. Before December, 1911, less-than-carload express and freight service was run with passenger cars to form an accommodation train. This service hindered the passenger business to a great degree, and the running time between Leamington and Windsor was two hours and fifteen minutes. This train was therefore replaced by the limited service mentioned, and arrangements were made to handle the less-than-carload business by the new combination express and freight car, which also hauls standard freight cars twice a day on regular schedule. The latter arrangement saves a great deal of mileage as compared with the former method of having a locomotive make a special trip for individual freight cars. The old locomotive formerly used for freight service is now employed for general utility service, including the hauling of passenger trailers, as shown in one of the accompanying illustrations.

As noted from the mileage figures previously quoted, the company does considerable freight business, most of which consist of local products like tobacco, grain, hay and live stock. Besides handling local business the company has through billing arrangements and physical connections with the Canadian Pacific and Père Marquette Railroads, with which it prorates in accordance with the regular steam railroad classification. Where there is competition with the steam railroads the electric railway usually gets the business because it gives two deliveries a day compared with one delivery by the steam railroads. The freight business has been built up by personal solicitation among the local men, who are asked to specify the electric railway for all through routing.



Locomotive Car with Four Trailers.

The company has a large freight terminal at Windsor, a transfer station at the junction with the Canadian Pacific Railroad, a freight house at Leamington and a yard for live stock at Cottam. It has recently completed at Essex a handsome combination passenger and freight station. The station building, 32 ft. x 27 ft. 4 in. in area and constructed chiefly of brick, contains a waiting room and offices. It is adjacent to a corrugated-iron freight shed, which is 52 ft. long at the wagon delivery side and 41 ft. long at the track platform side.



Curves Showing Ratio Between Gross Earnings and Operating Expenses, and Increase in Gross Earnings.

On this line the growth of the freight business is merely a question of facilities. Thus the new express car has already secured a great deal of new business, and it is believed that the new depot at Essex will increase the earnings from this branch by about 50 per cent. It is likely, therefore, that additional sidings and freight houses will be built in the near future.

The improving financial condition of this property is indicated by the fact that the operating expenses for the fiscal year ended June 30, 1911, were 63.27 per cent., and for the fiscal year ended June 30, 1912, 59.52 per cent. of the gross earnings, in spite of the large amount of rehabilitation. The curves show by months how the gross earnings have increased and the proportion of operating expenses has decreased since June, 1910. The improvements have been made under the direction of Albert Eastman, general manager, who created and built up the freight and express business of the Utica (N.Y.) & Mohawk Valley Railway before assuming the management of this property.

EFFECT OF TRAFFIC ON BITUMINOUS PAVEMENTS.*

By Isaac Van Trump, Engineering Chemist, Chicago.

A new problem has arisen within the past year or two which the paving engineer must solve, and that is the deep ruts formed in bituminous roadways under exceedingly heavy motor traffic. The writer has in mind two boulevards, paved about 12 years ago with sheet asphalt. Until less than two years ago these thoroughfares were, after 11 years of constant traffic, still in perfect condition. During the summer of 1911 slight ruts appeared in the pavement, gradually becoming deeper until during the past hot season it became almost dangerous for a fast moving vehicle to use that portion of the street. In the writer's opinion this pavement, which had for 11 years been perfectly hard and stable, gradually became softened and displaced under the tremendously increasing automobile traffic and the minute oil drippings. It has been estimated that 17,000 vehicles, principally automobiles, pass over these pavements each day, a large percentage of which are homeward bound between the hours of 4 and 7 p.m., when the pavement, especially during the summer, is still warm and yielding from the hot sun.

It is, of course, well known that asphalt pavements become harder with age, but on the two boulevards above mentioned the condition of the pavement after years of service is reversed and it is now the problem of the paving engineer to prepare and lay a bituminous pavement which will not be seriously affected by the minute but constant dripping of oil and gasoline from automobiles. Neither is the above condition confined to sheet asphalt alone, as a similar condition existed on another portion of one of these same boulevards, paved in 1907 with bituminous concrete containing a coal-tar binder. Deep ruts appeared in this pavement within two years after laying, making it necessary to resurface the entire roadway.

Some few municipalities are advocating the elimination of the binder course. In many instances to economize in this manner is a serious mistake. A dense binder not only acts as an anchor for the wearing surface by giving added rigidity and stability to it, but it also protects the upper surface to a considerable degree from the deleterious action of water and illuminating gas from beneath. Many concrete foundations exude moisture under certain atmospheric conditions. The opportunity for street liquids to get beneath pavements from along car tracks, gutters and headers, and around manholes and catchbasins is great. Where no binder is employed, these liquids have easy access to the under side of the wearing surface.

To prevent the wearing surface from creeping under traffic some municipalities substitute a paint coat in place

* Abstract of paper read before American Society of Municipal Improvements, Dallas, Texas, Nov. 12-15.

DIMENSIONS OF PIPE					SAFE LOAD IN POUNDS — STANDARD WROUGHT PIPE COLUMNS — Quiescent Loads—40,000 Ultimate—Factor of Safety of 7												
INCHES			SQUARE INCHES	POUNDS	LENGTH OF PIPE—FEET												
Nominal I. D.	Actual O. D.	Thickness of Metal	Area of Metal	Weight per Foot	6	7	8	9	10	11	12	13	14	15	16	17	18
1	1.315	.134	.495	1.67	......	......	......	......	......	......	......	......	......	......	......	......	......
1¼	1.66	.14	.668	2.24	......	......	......	......	......	......	......	......	......	......	......	......	......
1½	1.90	.145	.797	2.68	......	......	......	......	......	......	......	......	......	......	......	......	......
2	2.375	.154	1.074	3.61	5,085	4,785	......	......	......	......	......	......	......	......	......	......	......
2½	2.875	.204	1.708	5.74	8,520	8,120	7,720	7,350	......	......	......	......	......	......	......	......	......
3	3.5	.217	2.243	7.54	11,700	11,300	10,940	10,520	10,100	9,670	......	......	......	......	......	......	......
3½	4.00	.226	2.679	9.00	14,280	13,940	13,600	13,150	12,650	12,280	11,880	......	......	......	......	......	......
4	4.50	.237	3.174	10.66	17,140	16,850	16,450	16,050	15,650	15,200	14,720	14,280	13,820	......	......	......	......
4½	5.00	.246	3.674	12.49	20,000	19,710	19,430	19,030	18,630	18,170	17,720	17,250	16,790	16,330	......	......	......
5	5.563	.259	4.316	14.50	23,780	23,480	23,150	22,740	22,400	22,000	21,540	21,030	20,570	20,050	19,550	19,030	......
6	6.625	.28	5.584	18.76	31,030	30,740	30,450	30,100	29,720	29,310	28,900	28,450	28,000	27,550	27,020	26,500	25,910
7	7.625	.301	6.926	23.27	38,800	38,500	38,200	37,900	37,500	37,100	36,680	36,280	35,760	35,250	34,740	34,230	33,720
8	8.625	.322	8.386	28.18	47,200	46,900	46,630	46,280	45,900	45,630	45,200	44,700	44,230	43,760	43,250	42,750	42,180
9	9.625	.344	10.03	33.70	56,570	56,290	56,000	55,700	55,400	55,100	54,650	54,250	53,750	53,250	52,750	52,230	51,750
10	10.75	.366	11.924	40.06	67,500	67,200	66,900	66,600	66,300	66,000	65,600	65,200	64,750	64,250	63,750	63,200	62,600
12	12.75	.375	14.579	48.98	82,750	82,500	82,280	82,000	81,720	81,450	81,060	80,680	80,280	79,880	79,480	79,000	78,570

From the Valor World, October, 1912.

of a binder course between the concrete base and the surface mixture. Theoretically a paint coat forms a perfect bond between the two courses, but at best it is difficult and inconvenient to prepare and apply, and unless the conditions on the street are ideal the practical results are frequently entirely different from those obtained in theory.

Also for the purpose of overcoming the tendency of the wearing surface to shove under traffic, several cities have recently adopted what is known as "anchor concrete," a form of construction patented by W. B. Brady, of Chicago. Anchor concrete is merely a slush coat of cement mortar spread ½ in. deep upon the freshly laid concrete foundation. Before this slush coat has received its initial set, clean, hard, broken stone about 1½ to 2 in. in diameter is spread evenly over it and imbedded into the slush coat by light tamping. When dry, this produces a very rough but rigid surface and acts as an anchor for the topping which is laid directly upon it. This form of construction is especially effective on steep grades.

Where the traffic is light, such as on suburban or residential streets, it may be possible to eliminate all forms of intermediate courses and lay the wearing surface directly on the concrete base, but to do away with the binder course generally, as a few municipalities have recently done, regardless of traffic or other conditions, is a serious error.

STANDARD METHOD OF TRAFFIC RECORDING.*

The object of this report is to suggest a uniform method of recording, analyzing and standardizing quantity and weight of traffic on streets and roads, and for reducing it to unit bases of quantity and of tons per yard of used traffic width of roadway per day, or per square yard of used roadway surface, which it the same thing. It is wise to recall the two legitimate causes of wear and destruction of pavements; they are traffic and weather, separately and combined. Many records of traffic have failed to state the width of the road and are defective in other respects. Many cannot be reduced to any unit basis for comparison with one another. Many have unnecessarily subdivided the vehicles into too many kinds, sizes, etc., by methods which are complicated and unnecessary for practical, general use. Traffic records should be based on a simple, accurate method of counting and recording traffic and reducing it to standard units of quantity and tonnage. The method should be such as to be quickly understood and applied.

The period during which traffic should be counted is for 12 consecutive hours from 7 a.m. to 7 p.m. and during six consecutive or other different week-days. If average weather and what is known to be average traffic conditions are selected, then a record for only three consecutive week-days gives valuable information. No traffic should be counted in abnormal seasons of snow and ice, nor during continuous rainy, very cold or excessively hot days. The traffic should be counted at or near the centre of a block and not at an intersection of two streets. The traffic is that which passes both ways along the street or road.

The general classification of vehicle traffic for practical results, is as follows: First, horse vehicles, subdivided for vehicles drawn by one. two and three or more horses; second, auto vehicles. The vehicles and horses must both be considered in computing the weights of traffic from the quantities counted and recorded. For general traffic counting and the reduction of the quantities of vehicles to tonnage of traffic, the average weight of all vehicles, empty and loaded, drawn by one horse can be taken as 1 ton of 2,000 lb.; by two horses as 2 tons; by three or more horses as 4 tons. In like manner the average of all auto-vehicles, loaded and empty, for transportation of persons and goods can be taken as 1¾ tons. All bicycles and ridden horses, because light and very few, are best omitted from street traffic recording.

For recording traffic, sets of four cardboard slips, about 9 x 2 in., fastened together at the end, may be used; twelve sets are needed. One set is used for each hour. Each set is marked for location where traffic is counted, name of observer, date, the hour represented by the set (as 7 a.m. to 8 a.m., etc.). There must be at least two observers for each location, to relieve each other at the end of each hour or two hours, because one recorder cannot work accurately for a longer period. An ordinary conductor's punch is needed and a hole is punched in a slip for each vehicle passing in either direction along the street in front of the recorder. One-horse vehicles are punched on white cardboard; two-horse on yellow; three and more horse vehicles on red; all auto vehicles are punched on blue slips.

A blank form for one-day traffic record consists of a consolidated record of the quantity of traffic during each of the twelve hours from 7 a.m. to 7 p.m., with totals and reductions to unit bases. It gives details of name of city, width of roadway, effective width used by traffic, which averages ½ yd. less on each side or 1 yd. less than the full width between curbs or edges of the street, the kind and quality of pavements, the weather and other needed facts are shown. This form reduces the one day's traffic to standard units which are the total vehicles and total tons of traffic on the whole street; also per yard of effective width of the street. This is the equivalent of number of vehicles and tons per square yard of used roadway surface.

From the forms for the one-day traffic records a consolidated traffic record is compiled. It consists of a condensed statement covering the six or other number of days' traffic. It shows the data day by day, together with the final totals and the average per day. These totals are reduced in quantity and tons to the standard units of yard of effective width (square yard) of roadway surface subjected to the traffic. These are the true bases for comparing the traffic of one street with another and for establishing the relation of different amounts of traffic to wear on pavements, cost of maintenance and for many other useful purposes.

Traffic records are seldom needed annually; but at longer intervals up to once in five years or according to local conditions.

* Committee report of J. W. Howard, consulting engineer, New York, chairman, presented before American Society of Municipal Improvements, Dallas, Texas, Nov. 12-15.

NOVEL METHODS OF HAULAGE.

During the operation of excavating for the foundations of large buildings it is a familiar sight to see an additional team whose duty it is to assist the haulage of the earth wagon to the road level, but this method has been superseded by a donkey engine at the corner of Simcoe and Richmond Streets in the city of Toronto.

The donkey engine is located on the roadway at the top of the incline, which is exceptionally steep, and uses the curbing as a brace. When a wagon has been filled and moved by the horses to the bottom of the incline, a cable is let down and secured to the tongue of the wagon by a hook; the horses are started on the upward path as the throttle is opened and it is interesting to see mechanical horse-power pitted against the more fleshy nature. If any conclusions are to be drawn from the action of the horses a by-stander would take it that the horses imagine they are on an elevator.

REPORT ON WATER SUPPLY AND FIRE-FIGHTING APPLIANCES OF VICTORIA, B.C.

An exhaustive report on the water supply and fire fighting appliances of the city of Victoria and district has been prepared by Mr. H. R. Page, secretary-treasurer of the Vancouver Island Fire Underwriters' Association.

The report expresses the opinion that a conflagration hazard exists in Victoria owing to the narrowness of the streets in some instances, and the congested condition of a number of the mercantile blocks, which are solidly built up and lack lanes or other modes of access to the rear of the buildings.

The report considers there is no conflagration hazard in Oak Bay, but the abandoned shacks at Wharf Street, Esquimalt, are a danger.

The fire losses, the report says, have been rather severe during the past few years, the losses paid by insurance companies being as follows:—

1909	$ 74,435 00
1910	582,975 00
1911	128,377 00
1912 (to end of October)	128,584 00
Total	$914,471 00

or roughly calculated, slightly more than 60 per cent. of premiums received during the same period.

The Victoria city council decided to refer the report to the fire wardens, fire chief and water commissioner.

The mayor remarked that they would search in vain for any reference to the reduction of premiums. They had doubled in the last 18 years, steadily advancing from time to time as the city improved the fire brigade equipment.

The following findings of the report contain the observations of Mr. Page on the application of the city's apparatus to cope with an emergency:—

"The consumption has outgrown both the supply and capacities of the supply mains and pumps; at the present moment, with the Beaver Lake and North Dairy pumping stations in operation to the limit of their output, which equals approximately 4½ million gallons per 24 hours, there is a gradual drop of the water stored in Smith's Hill reservoir.

"This during a season when the consumption is probably at its minimum, promises a serious condition of affairs during the coming summer unless some provision is immediately made for increasing the supply.

"Further, the supply mains mentioned in this report are single lines, and have been laid for a period of 20 years or more, also the pumping units are not in duplicate, and should the larger pump at the North Dairy station, which has been steadily in commission for the past year, become inoperative through any cause, the city, or a large portion of it, would be without water for domestic purposes.

"The attention of the civic authorities has been drawn to these matters at different times during the past three years, and beyond repairing of the reservoir no material improvements have been made towards insuring an adequate domestic supply.

"It is proposed, and the work is at present under way, to bring water from Sooke Lake, some 27 miles distant; but this work, at the present rate of progress, will not be completed before 1914. It therefore becomes necessary to make some temporary provision, the two most feasible propositions being to lay a new supply main from Elk Lake to Smith's Hill reservoir and install additional pumping machinery at the North Dairy station, or connect the 36-inch main now laid on Gorge road with the Esquimalt Water Works Company's main. Should the latter course, which would appear the most simple, be adopted, the actual work of connection could be completed within two months, but under their charter the Esquimalt Water Works Company are privileged to demand 15 months' notice before such connection can be made, and also that a minimum of 500,000 gallons of water per day, at the rate of 6c per thousand gallons, be accepted for a period of not less than five years. Taking it for granted that the period of notice be waived by the company, and that the joint trouble in their supply main has been remedied, and considering that the head is sufficient to supply Smith's Hill reservoir without recourse to pumping, and the quality of the water unquestionably superior to that of Elk Lake, the latter proposition should be preferable.

"A large percentage of 4-inch pipe has been laid in James Bay district, and the section between Hillside, Tolmie, Victoria and Sidney Railway and Cook Street being particularly bad in this respect.

"The hydrants in some dwelling sections are widely scattered, while in the outlying business area the distances between hydrants runs as high as 500 feet. In such blocks intervening hydrants should be installed.

"When taking pressure tests, a number of hydrants were found in poor condition, three within the business area being entirely out of commission. A thorough inspection is recommended of all hydrants and also that all faulty ones be replaced by an approved pattern of hydrant having a steamer connection, and also that where the main permits, the branch connections be not less than 6-inch.

"Service mains running parallel on Wharf, Government, Douglas and Blanchard Streets would be materially assisted if cross connected, say, at Discovery, Cormorant and View Streets, also more gate valves should be provided; under present conditions a break in any one of these pipes during fire service would cause serious delay owing to the distance apart of the salt water hydrants in an easterly and westerly direction.

"As before stated, the salt water mains, when not in commission, are kept filled with fresh water and connected to the domestic system. In order not to waste the 65,000 gallons required to fill the system after service, the high pressure pumps are not started until a second alarm is sent in. As the steamers frequently connect to the high pressure hydrants for suction, there would appear to be a possibility of serious consequences in the event of a fire getting out of hand during the interval between releasing the steamer and changing the hose lines to the salt water hydrants. However, this is a matter that will be remedied when the scarcity of fresh water ceases to be a factor for consideration.

"The wires carrying the current from the British Columbia Electric sub-station to the salt water pumping plant should be in duplicate and underground in conduit, and kept live at all times, thus doing away with the manual agency at the substation. These wires should also enter the pump room direct, without passing through workshop and room in which the distributing tower is located.

"At time of inspection the North Dairy pumping station was practically without fire protection, one fifty-foot length of hose without a nozzle being the only equipment on hand. The two adjacent fire plugs should have hose and nozzles permanently attached.

"This department has kept pace with the growth of the city, the equipment being fully modern and organization good. The strength of the brigade has doubled in the past three years.

"The headquarters station is located in a poor class of building, originally constructed for a market. This constitutes a serious hazard to the alarm system, the central station of which is located at this building. Should a new fire hall not be contemplated within reasonable time, it would be as well to have the alarm equipment housed in a separate fireproof building.

"The city by-law re electric wiring is incomplete and elastic, the system of inspection inefficient; on the whole, however, the new work is comparatively good, but a large amount of old wiring should be condemned.

"The building by-law recently adopted covers the ground fairly well, but makes no provision for mandatory protection of exposed openings in district B. This is an important feature, especially in blocks having no lanes, and where buildings on either street are built back to within a few feet of one another.

"The building inspector's department is apparently understaffed, and during the busy season unable to carry on the necessary supervision, but I have at all times received most courteous attention when reporting any defects."

THE DEVELOPMENT OF DIESEL MARINE OIL-ENGINES.

Among sundry notices that have recently appeared in the press about new engine works for the development of Diesel oil engines for ocean-going ships, little notice has been taken hitherto of progress made in this direction on the River Tyne. Messrs. Swan, Hunter & Wigman Richardson, Limited, at their Neptune Engine Works, Walker, Newcastle-on-Tyne, have for some years been actively engaged in studying and developing Diesel oil engines.

Diesel-engined Ships.—Two years ago they completed a twin-screw cargo ship called the "Toiler" which has the distinction of being the first oil-engined vessel to cross the Atlantic. She is owned by Mr. James Playfair, of Midland, Ontario, and trades in the Great Lakes of North America. Her builders at once followed up the "Toiler" with another similar twin-screw cargo steamer for the same owner. The vessel is called the "Calgary," and has greater engine power than the "Toiler." She has been safely delivered at her destination in Canada, and trades on the Great Lakes. Messrs. Swan, Hunter & Wigham Richardson, Limited, are now engaged in the construction of two much larger cargo boats for British owners, and carrying about twice the deadweight of the "Toiler" and "Calgary."

Electric Transmission.—In addition to these ships the same builders have in hand another interesting ship being built for the Montreal Transportation Company, of Montreal. This will be the first large vessel designed for propulsion by power transmitted electrically from the engine to the propeller. The designs of the engines have been executed by Mr. Henry A. Mavor, of Messrs. Mavor & Coulson, of Glasgow, who have already tried this system on a small experimental vessel called the "Electrical Arc." The deadweight cargo capacity will be about 2,500 tons. The machinery will consist of two 300-h.p. high-speed Diesel engines, each with its own alternating current generator and exciter. Just ahead of the thrust block there will be a specially designed motor operating a single propeller, and reducing the 400 revolutions per minute of the Diesel engines to about 80 revolutions per minute. Among the adadvantages claimed for Messrs. Mavor & Coulson's system of electrical transmission it may be noticed that the total power of the propelling engine required in a single unit for direct drive can be split up into several sub-units, each with its own generator, all connected to a single propelling motor. Furthermore, all reversing and speed changes can be done by switches, and the electrical control station can be placed in any convenient spot in the ship, e.g., on the navigating bridge, in the engine-room, or elsewhere.

The "Neptune-Diesel" Engine.—Messrs. Swan, Hunter & Wigham Richardson, Limited, have for some little time been developing two-stroke cycle Diesel engines. Various well-known designs of this type of engine have been critically examined and the details exhaustively analyzed. The outcome of all this study has resulted in the "Neptune-Diesel" engine, which for marine purposes is claimed to be second to none. The resign is substantial in its strength, no undue risks being taken by imprudently cutting down weights. Another leading feature is much greater simplicity than is found in many Diesel engines. This means a smaller prime cost and less expense in running and maintaining the engine. The builders have also aimed at easy accessibility to all parts of the engine, which is of the highest value, if ever repairs are necessary. Several radical improvements have also been introduced in the valve gear, pistons and cooling arrangements, all of which are distinctive features in the "Neptune-Diesel" engine.

New Engine Works.—The Neptune Engine Works, which have been established since 1879, have been frequently enlarged and improved, and the best of modern machines have from time to time been installed to replace older tools. Partly in order to develop the "Neptune-Diesel" engine more successfully, and also owing to the general expansion of business, Messrs. Swan, Hunter & Wigham Richardson, Limited, have now embarked upon a complete reorganization of their engine works. This department is to be moved to another site within the Neptune shipyard, and entirely new shops are being erected. The present buildings of the engine works will be used for the shipyard blacksmiths, plumbers and angle-smiths. For some months Messrs. Swan, Hunter & Wigham Richardson, Limited, have been busy clearing a plot of ground of about three acres in extent, with a splendid river frontage. The old Anglesey Cooper Works of Messrs. Henry Hills & Sons formerly stood on this spot. These buildings have been entirely pulled down, chimney stacks demolished, and fresh foundations laid for the new engine works. These new buildings will touch the existing boiler shop of the firm, which is a lofty building 220 feet long by 120 feet wide. The whole of this department for building both engines and boilers will then be at the north end of the Neptune shipyard and will be adjacent to the dry dock department of the firm, giving further splendid facilities for executing repairs to ships and engines with rapidity and economy. Mr. David Purdie, of Shields Road, Newcastle-on-Tyne, has the main contract for piling and excavating.

The new engine buildings are being built of brick and galvanized iron, with glass roofs, most of the work being undertaken by the Clyde Structural Iron Company, Limited, of Scotstoun, Glasgow. Apart from smaller erections the main building will measure about 300 ft. by 200 ft, divided into six bays, and comprising a combined machine and erecting shop. A considerable amount of modern machinery of the latest and best designs will be installed. A new railway siding is being made and the lines from the North Eastern Railway Company will be led right into the shop so as to facilitate the discharge of material coming from distant parts. The river front is being furnished with a completely new jetty making a deep water berth for ships lying alongside. This new wharf will be extended along the front of the Neptune north yard and will be joined to the older portion, making in effect a fitting out berth 1,800 feet long. The existing 80-ton sheer legs at the old Neptune Engine Works quay will be used to help the completion of ships after they are launched. The 150-ton floating crane "Titan," belonging to Messrs. Swan, Hunter & Wigham Richardson, Limited, will be mainly used to lift sets of engines entire from the new engine works quay into ships. This, of course, means a very great economy, saving a great deal of labor in dismantling and re-erecting an engine. This is another example of the splendid and powerful modern plant possessed by these builders. The utility of their floating crane "Titan" has been much appreciated by other firms, for it is frequently hired for lifting heavy weights on board warships and merchant vessels, and it has also been sent to neighboring ports for harbor work, such as lifting and laying concrete blocks, drawing piles, etc.

COAST TO COAST.

Kingston, Ont.—The building permits of this city for the month of November last show an increase of 675% as compared with the same month in 1911.

London, Ont.—The report of Prof. Angus, Toronto, on the cost of lighting the streets of London, is now in the hands of City Clerk Baker. Mr. Angus in this report states that the sum of $19,000 is adequate for the service rendered the city. This is about $1,000 larger than the cost as estimated by Ald. Richter, and just $11,000 less than the amount charged by the water commissioners at the present time. Mr. Angus, in his statement, includes profits, which he figures at $2,000. This is a trifle more than 10 per cent., which is not a bad profit for hydro-electric, all things considered.

Merriton, Ont.—The Riordon Paper and Pulp Co., will undertake the erection of a large new plant at Merriton, Ont. A site has been selected near the present mills and the outlay will amount to about a million and half dollars. The company is capitalized at $6,000,000 and recently $1,500,000 bonds were issued for improvements and extensions to the various plants of the company. At Hawkesbury, Ont., extensive enlargement is now under way, and the daily output of 100 tons of dry sulphite pulp will be increased by 40 per cent. Two new digesters, each of 12½ tons capacity, are being installed. A new digester, house, a new boiler house three new acid towers, and additions to the wood room and shipping room are being rushed to completion. The sulphite mill at Merriton has a capacity of twenty-five tons of moist sulphite pulp per day; twenty-one tons of ground wood-pulp and about the same amount of wallpaper and building paper.

Gaspe, P.Q.—H. Hilyard, of Dalhousie, N.B., acting on behalf of the St. Maurice Lumber Company, has acquired all the properties of A. W. Carpenter, of London, England, formerly carrying on business at Gaspe Basin, under the title of the Gaspe Lumber and Trading Co. The purchase price is understood to be in the neighborhood of $250,000, for all the holdings. The trustees, the Charing Cross Bank of London, took over the property after the failure of Mr. Carpenter. Mr. Hilyard will immediately proceed to develop the property at Gaspe, and it is understood that the construction of a large sulphite mill will be commenced. Included in the property acquired are the wharves of the Gaspe Lumber and Trading Company which command the best situation in Gaspe harbor. The Atlantic Quebec and Western Railway which Mr. Carpenter started is now running into Gaspe Basin and in a short time the Matane Railway will also reach the town.

Dryden, Ont.—The Dryden Timber and Power Company, of Dryden, Ont., which is completing a sulphate plant and a paper mill for producing building and heavy wrapping papers, received a heavy setback recently when the power house and sluice gates were destroyed by fire, as stated in our contemporary paper. In the power house there were two turbine units of 950 hp. each connected direct to two, 750 kva generators. It was the intention to generate the current at 600 volts and distribute it through the various motors in the buildings. The concrete dam across the Wabigoon river is 140 feet long and 20 feet high, giving an available head of 45 feet. The location of the power house was at the foot of the lower falls, and the hydro-electric equipment had been installed. The loss by fire will reach $100,000 and it is said that it will fall on Harris & Harris, contractors, who had the work on the concrete dam and power house nearly completed. J. B. Beveridge is the manager of the Dryden Timber and Power Company. It was calculated that the work under construction at Dryden, including the paper and pulp plants and the hydro-electrical development, would involve an expenditure of nearly three-quarters of a million dollars.

THE ROAD EXHIBITION.

An exhibition of road materials, appliances, and machinery used for the construction, maintenance and improvements of roads, will be held at the Royal Horticultural Hall, Vincent Square, Victoria Street, London, S.W., in connection with the Internatioal Road Congress to be held in London in June, 1913.

It will be opened on Monday, June 23rd, by the Right Hon. Earl Beauchamp, first commissioner of H.M. office of works, president of the exhibition committee, and closed on Saturday, June 28th.

The exhibition is to be international and is open to all classes of machinery, apparatus, materials, models, drawings, plans and maps illustrative of road construction.

A piece of ground adjoining the Royal Horticultural Hall, will be completely roofed and walled in, and paved with wooden sleepers to form an exterior section of the exhibition, for the exhibiting of heavy machinery.

A room fitted up as a writing room will be available for the use of members of the congress and exhibitors, and at a marquee in the ground, tea will be served to all members and exhibitors on production of their membership cards.

All the leading firms engaged in the industry have decided to exhibit. They are representative of all branches of the industry, and include:

Tar-Macadams, Etc.—Messrs. Tarmac, Limited; Gas Light and Coke Co., Limited; Canadian Rubber Co., Limited; Roadamant, Limited; F. E. Bristowe & Co.; Anglo-American Petrol Products Co., Limited; Taroads, Limited; Rocmac, Limited; Roadite, Limited; Limmer Asphalt Co., Limited; Neuchatel Asphalt Co., Limited; Dussek Bitumen Co., Limited.

Machinery.—Messrs. J. & P. Hill, Limited; Barford & Perkins; T. Green & Sons; Aveling & Porter.

Quarries.—Messrs. Ellis & Everard; Enderby & Stoney; Stanton Granite Co., Limited; London Granite Co., Limited.

Publishers.—Messrs. Illiffe & Sons, Limited; John Hutchinson; Roads Improvement Association; Good Roads; Crompton & Co.

Mr. Maybury, county surveyor, of Kent, is honorary secretary of the exhibition committee.

It is expected that representatives from between two thousand and three thousand highway authorities from all parts of the world will attend the exhibition.

HEAT AND POWER FROM SAWDUST.

An application has been made to the city of Vancouver by ten prominent saw-mill owners for a franchise to sell steam heat and electric light and power generated by burning saw-mill refuse. The application came immediately after the report of a committee of the City Council dealing with the smoke and saw-dust nuisance due to burning mill refuse in the city.

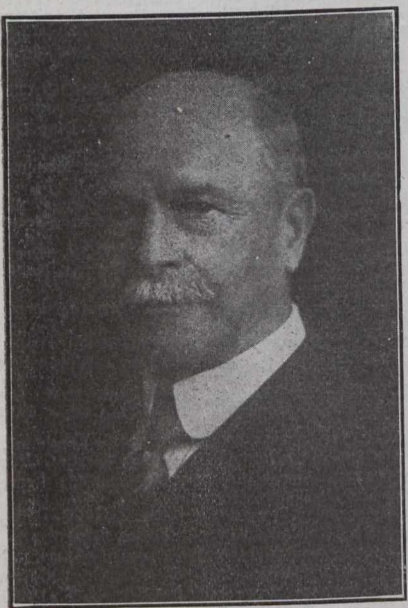
It is proposed to install plants for burning the refuse at each of the various mills, thus permitting a wide zone of distribution and enabling steam heat to be furnished at much lower pressure than from one central plant. The intention is to establish an auxiliary oil-burning apparatus at each mill for use in case of accident to the main plant and also whenever the supply of refuse runs low.

The problem of disposing of refuse without a loss has confronted mill owners for years and with coal selling at $7.50 a ton retail in Vancouver, it is thought that this scheme for utilizing it will prove successful. It is estimated that these mills have 114,000 cords of refuse and sawdust to burn each year. The approximate cost of installing each burner is placed at $30,000, and the annual operating cost at $5,000.

PERSONAL.

MR. C. B. HANDCOCK, construction engineer of the Manitoba Government Telephone Department, has resigned his position. It is reported that he will enter private business.

ROBERT W. HUNT, of Chicago, widely known as the head of the firm of Robert W. Hunt & Co., Limited, has been awarded the John Fritz medal for this year. This medal was founded in 1902 in honor of the veteran iron master whose name it bears "to commemorate notable scientific and industrial progress." Capt. Hunt was one of "John Fritz's boys." When about 20 years old he began work in the iron industry at Pottsville, Penn. Later he studied chemistry and became the chemist of the Cambria Co. He was at various times superintendent of steel works in Wyandotte, Mich., Johnstown, Penn., and Troy, N.Y. In 1888 he founded the firm of R. W. Hunt & Co., consulting engineers, inspectors, etc. He served in the Civil War from 1861 to 1865, rising from private to captain. The previous awards of this medal, besides the initial presentation to Mr. Fritz, have been to Lord Kelvin, George Westinghouse, Alexander Graham Bell, Thomas A. Edison, Charles T. Porter, Alfred Noble and Sir William White.



Capt. R. W. Hunt.

JOSEPH OWEN, late of the engineer's department, London County Council, England, was recently appointed assistant city engineer of Fort William, Ont. Mr. Owen was articled to Mr. T. Aird Murray, consulting engineer, Sheffield (now in practice at Toronto), for four years, and remained in the capacity of assistant for a further period of eighteen months. During this time he was engaged on extensive water supply, sewerage, and sewage disposal works for various municipalities, chiefly in the capacity of resident engineer. He then held for four years the position of assistant district engineer in the city engineer's department, Sheffield, where he left to take up the position of resident engineer on street railway and sewerage works for the Colchester Corporation, in which capacity he remained two and one-half years. Six and one-half years ago Mr. Owen joined the staff of the London County Council as assistant engineer, and obtained extensive experience on street and bridge improvements, and street railways on the conduit and overhead systems. Mr. Owen received his technical education at the Sheffield University, and is by examination an Associate Member of the Institution of Civil Engineers, a member of the Royal Sanitary Institute, and an Associate Member of the Institution of Municipal and County Engineers. Shortly prior to leaving England, Mr. Owen was elected to the Executive Committee of the latter institution, and about the same time was appointed lecturer in road construction, drainage, and sanitation at the Holloway Polytechnic Institute to prepare students for the Surveyor's Institute final examinations.

RALIROAD EARNINGS.

The following are the railroad earnings for the week ended November 7th:—

	1911.	1912.	Increase or Decrease.
Canadian Pacific	$2,493,000	$2,938,000	+$445,000
Grand Trunk	956,818	1,061,984	+ 105,166
Canadian Northern	526,000	590,300	+ 64,300
Temiskaming & N. Ontario...	38,693	32,011	— 6,682

The following are the railroad earnings for the week ended November 14th:—

	1911.	1912.	Increase or Decrease.
Canadian Pacific	$2,486,000	$2,916,000	+$430,000
Grand Trunk	959,980	1,064,317	+ 104,337
Canadian Northern	504,000	609,500	+ 105,500
Temiskaming & N. Ontario...	35,794	28,864	— 6,930

For the quarter ending September 30th the receipts of the Guelph Junction Railway amounted to $12,072.70. The receipts for the other three quarters were $8,794.93, $6,510.36, and $8,840.30, making a grand total of $36,227.29 for the year.

The statement of earnings of the Canadian Northern Railway for October shows a gross increase of $322,300; net increase is $24,900. The four months' figures of the company, from the beginning of the new fiscal year on July 1st last to October 31st, make a more favorable showing in this respect, a gain of $1,096,400 in gross being accompanied by a gain of $218,100 in net.

The statement for the month follows:—

	1912.	1911.	Increase.
Gross earnings............	$2,351,200	$2,028,900	$322,300
Expenses	1,645,900	1,348,500	297,400
Net earnings	705,300	680,400	24,900
Mileage in operation.......	4,297	3,731	566
	July 1 to date.	July 1 to date.	Increase.
Gross earnings	$7,598,200	$6,501,800	$1,096,400
Expenses	5,604,000	4,725,700	878,300
Net earnings	1,994,200	1,776,100	218,100
Mileage in operation........	4,297	3,717	580

VICTORIA'S BUILDERS ARE BUSY.

When the building permit was issued for Victoria's new high school, costing $416,750, the permits for structures aggregated $7,217,000 to date since the beginning of the current year.

The total building permits for 1911 amounted to $4,025,000.

With the permits for Oaklands and Quadra Street schools, costing nearly $100,000, to be issued next month, and the many private residences and stores now being planned, the grand total will be over eight millions, or twice the total of permits for last year. Oak Bay, Victoria's important residential suburb, has constructed over one million dollars' worth of building this year.

Greater Victoria's permits, including Oak Bay, Esquimalt and South Saanich, amount to nearly ten million dollars.

MEETINGS.

The annual meeting and dinner of the Manitoba branch of the Canadian Society of Civil Engineers were held Thursday evening, December 5th, at the Royal Alexandra, Winnipeg. At the business meeting, over which Col. Ruttan presided, J. T. Legrand, bridge engineer of the G.T.P., was elected chairman; E. Brydone Jack, secretary-treasurer, and W. A. Duff, D. A. Ross, W. L. Mackenzie and Frank Lee, executive committee. At the banquet, Prof. Featherstonhaugh presided in the absence of Mr. Hesketh. This branch has now about 70 members.

The ninth annual convention of the American Association of Manufacturers of Sand-lime Products was held in the King Edward Hotel, Toronto, on December 4th. The convention is held for the first time in Canada, and was largely attended by the foremost manufacturers from the United States and the Dominion. The meetings were presided over by President S. O. Goho, of Harrisburg, and Secretary W. E. Plummer, jr., of Buffalo.

A meeting of the mechanical section of the Canadian Society of Civil Engineers was held in the rooms of the Montreal Club of this society on December 5th last. Mr. Russel S. Smart, A. M. Can. Soc. C.E., entertained those attending by an address on "Patent Law from an Engineer's Standpoint."

COMING MEETINGS.

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

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

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

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

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

ENGINEERING SOCIETIES.

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

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

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

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

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

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

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

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

MUNICIPAL ASSOCIATIONS

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

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

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

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

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

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

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

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

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

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

CANADIAN TECHNICAL SOCIETIES

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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