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Volume 23 Toronto, August 29, 1912

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The Canadian Engineer

An Engineering Weekly

EDMONTON BENCH-MARKS.

By C. C. Sutherland, Roadways Department, Edmonton, Alberta.

The first bench-mark in the city of Edmonton was chosen on top of a stone ledge of the Bank of Nova Scotia. From this ledge levels were carried out and other bench-marks established, generally on the rim of manhole covers or on nails in electric light or telephone poles.

With the improvement of streets the manhole covers were adjusted and the poles removed, so that it soon became necessary to put in some permanent bench-mark system.

In 1908 a number of brass bolts, turned up at one end, were placed in public buildings throughout the business section of the city. The cost of the brass bolts was $1.25, and when established made a bench-mark costing approximately $3.25 each.

It was intended that as a district developed a complete system of bench-marks would be installed in this way, but for some reason the heavy buildings in the city do not stand well on this soil, and hence do not make good bench-mark supports. For example, we placed a bench-mark on the new Government post-office, and found by comparing it with old-established bench-marks that after one year it had settled 0.10 of a foot.

During the fall of 1909 bench-marks were placed at street intersections over a part of the city. These were made by boring a six-inch hole in the ground to a depth of four feet and refilling with concrete. In the top of the concrete was placed a rounded cast-iron bolt. The location of these bench-marks was kept as uniform as possible, being placed one foot off main streets and six inches from the property line. By this location it came at the inside edge of the plank walk, and was not disturbed by building operations except in some cases where the grade was lowered. The costs when complete was approximately $5. In dry, well-drained soil the elevations seem to remain constant, but in wet places it is found that the bench-marks have risen, probably due to frost.

In view of these facts it was thought advisable, in the spring of 1911, to lay the basis for a complete new system. As the city is crossed and recrossed with railways, it was decided to place this system along the right-of-way of the different railways, each bench-mark being about one-half mile apart. Upon the advise from the railway engineers they were located two feet from the boundary of the right-of-way as the position least liable to be disturbed.

These bench-marks were made by boring an eight-inch hole seven feet six inches below the general ground elevation and refilling with concrete. The last eighteen inches of concrete was placed in a piece of six-inch cast-iron water pipe, which acted as a casing, and allowed the top of the bench-mark to be raised six inches out of the ground. In the top of the concrete was placed a square brass bolt, 1 x 1 x 8 inches long, and a brass number plate, as shown on Fig. 1. The bench-mark was then covered with a wooden box, made with four pointed legs, that were driven down over it.

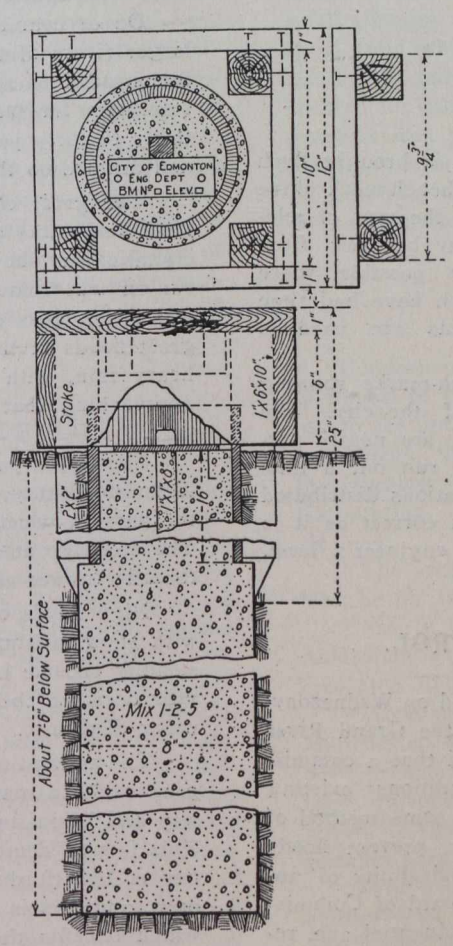


Fig. 1.

In establishing the levels in this main system the original elevation was taken from the top of the brass bolt in the corner of the Bank of Nova Scotia, this elevation being transferred from the stone ledge above it, which had been taken as the first bench-mark in the city. From there levels were carried to bench-mark No. 1, and hence around the system.

In carrying the levels two rods were used with each instrument, and by cross-reading two turning points were obtained for each set-up. The ground was covered three times, and an average of the six elevations taken. The closing error in approximately thirteen miles was 0.06 of a foot, this error being distributed proportionately to the distance from bench-mark No. 1. This formed the outline of a rectangular system, having its longest sides above two miles apart.

From this main system secondary bench-marks are run out to cover the entire area within the city limits. The secondary bench-marks are of three kinds: those used in undeveloped and outlying districts; those constructed in boulevard or residential districts, and those constructed in business districts. In the outlying sections of the city it is found that a railway spike driven in a telegraph or electric light pole makes a good bench-mark. The pole may be painted white underneath the spike and the elevation painted on in red.

For residential districts a bench-mark similar to the main system is placed in the parking of the boulevard, and is located out from the corner of the block so that it may be seen from different directions. In some localities it may be desirable to use the cast-iron cover instead of the wooden box.

In business districts, where the entire area is covered with sidewalks or roadway, we are locating bench-marks in the sidewalk area, at a corner along a property line, and three feet back from the curb face. The construction, which is shown in Fig. 2, is similar to that used in the main system, except that it is fitted with a cast-iron cap

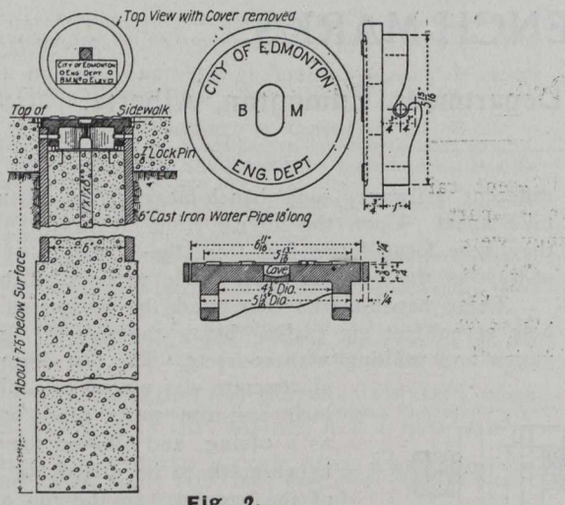


Fig. 2.

that locks into the iron casing. This cap is brought flush with the sidewalk level. By placing this bench-mark three feet back from the curb face it is out of the way of telephone or electric light conduits, and may be seen from four ways on intersecting streets. Where possible, those bench-marks established on buildings which have had time to settle and those of the earlier systems are used as secondaries.

The city has now a belt line of bench-marks running two miles apart throughout the length of the city. The elevations, as shown by the closing error, are nearly perfect. From this belt line secondaries are run out a mile on each side. This gives a system of elevations distributed over the total area of the city that are as correct as it is possible to make them with an ordinary engineer's level.

THE GRAND RIVER CONTROL.

The Ontario Government was approached on Wednesday, August 21st, by a deputation representing the Grand River Improvement League. The deputation asked that a commission be appointed to investigate the conditions existing along the Grand River, and to recommend some method of improvement to conserve the water supply, prevent floods during spring time, and to consider the advisability of instituting some plan of river control by a Board of Commissioners. The deputation was a large and influential one, representing eight urban and twenty suburban municipalities. Mr. J. P. Jaffray, of Galt, the chairman of the League, headed the committee. Mr. W. H. Breithaupt, M. Inst. C.E., presented the engineering aspects of the proposal to the members of the Government.

After the different arguments were presented, Premier Sir James Whitney expressed his sympathy with the movement and added that the Government would consider the possibility for conducting an investigation with regard to the entire province.

Mr. Breithaupt's argument is given in full herewith.

The Grand River from its source in Melancthon Township, Dufferin County, within twenty-four miles of Georgian Bay, to its outlet into Lake Erie, below Dunnville, has a length along its windings of approximately 140 miles. Its course is mainly southerly. Its drainage basin contains approximately 2,600 sq. miles, about one-sixth the area of the peninsula of south-western Ontario, and comprises nearly the whole of the Counties of Wellington, Waterloo and Brant and parts of Dufferin, Halton, Oxford, Wentworth, Norfolk and Haldimand. Tributaries of the Grand River are the Conestogo from the west, rising near the source of the main river, the Speed from the east, and the Nith from the west.

In topography South Western Ontario presents a high tableland, at elevation of from 1,400 to 1,700 ft. above sea level, near the northerly limit of the peninsula with slopes, abrupt toward the north and east, gradual toward the west, and at first steep, then gradual and becoming flat, toward the south-west and south, to the almost level rim of water of Georgian Bay and Lake Huron, with elevation of 581 ft. above sea level and Lake Erie, elevation 572. Its original condition was one of dense forestation. This has, except to small extent, disappeared, without, however, materially affecting precipitation, rainfall and snowfall, as shown by records extending over the past 60 years; the large surrounding bodies of water maintain humidity.

On or near the high table land rise practically all the larger rivers of the peninsula. Originally half or more of this headwater area was in dense swamp, excellent natural reservoirs for maintaining streamflow. During the past thirty to forty years these swamps have also been cleared and drained so that very little of them remains.

The great change that has come with deforestation of the country has been in the rate of run-off, of water precipitation, as shown in the flow of streams. Where formerly run-off was retarded and stream flow well sustained, the water now goes off rapidly, with the result that there are great floods at times of snow melting and floods after any heavy rain, with smaller stream beds dry and larger ones approaching that condition, during the dry months of the year.

The upper part of the Grand River, extending well into Waterloo County, and including the Conestogo tributary, is the part on which fluctuation of flow most largely depends. The drainage area of the upper river is at first flat and extended; further along it is steep.

High floods occur only once in the year, in the spring, with snow melting on the upper river. These floods have steadily become higher and the low water flow less. This year occurred the highest flood on record, in quantity of water discharge.

The prevention of damage by floods is to large extent practicable in many places by enlarging the regular waterway and by raising the banks by means of levees or dykes. This is well demonstrated on the Grand River by what the city of Brantford has done. Such control gives local relief only, and this is the only benefit. A method of control which benefits the whole river below where it is applied, and gives not only flood relief but also the great benefit of sustained flow, is of much greater advantage. Such a method is storage in sufficient quantity. Reforestation on a large enough scale to have proper effect would require so large an area as to render it of doubtful practicability on the Grand River.

The conditions determining requirement for storage are

(a) The flood flow of the river;

(b) The amount of sustained flow, for low water period, that can be provided for.

The maximum flood discharges this year, obtained approximately at Elora, at St. Jacobs on the Conestogo, at Bridgeport, at Galt, and at Brantford, demonstrate that if a flow of 12,000 to 15,000 cub. ft. per second for 48 hours can be held, flood control is entirely practicable, and enough water can be stored to give a minimum flow of 400 to 500 cub. ft. per second throughout the low water period and therefore throughout the year.

The drainage area of the main river above Waterloo Township is approximately 460 sq. miles, and that of the Conestogo River to its outlet approximately 330 sq. miles. Precipitation on this area is indefinitely known; it is taken to be between 30 and 40 inches of water per annum. On run-off there are no data. It appears likely that the minimum run-off is not under 12 inches of the precipitation, and this for 600 sq. miles of drainage area would give sufficient water.

A dischargeable storage capacity of two and one half billion cubic ft. would be ample to effect the desired purpose. This would mean an area of 5 sq. miles with 18 ft. average depth. It could be in several separate basins. The first thing to be ascertained is whether the topography of the river valley offers suitable basins and in location with enough contributary drainage area. There are various sites that appear to be well adapted.

The minimum summer flow on the lower part of the upper river (from a drainage area of more than 800 sq. miles) has been under 40 cub. ft. per second, while the maximum flood flow this spring at the same place was approximately 24,000 cub. ft. sec.; the low water flow one-sixth of one per cent. of the maximum flood flow.

A sustained flow of 400 to 500 cub. ft. sec. would mean a gain of 4,000 to over 5,000 h.p. on existing water power developments on the lower river alone and there would in addition be large available horse power, below the range of lowest level, at the storage basins. The gain in water supply, sanitation, and general benefit, due to well sustained flow of the river would be inestimable.

GRAPHITE MINING IN CEYLON.

An interesting account of the methods of mining graphite in Ceylon, the largest producer of this useful mineral, is contained in an advance chapter on graphite by Edson S. Bastin, of the United States Geological Survey, from "Mineral Resources" for 1911. The graphite is mined either from open pits or through vertical shafts connecting with underground workings. Most of the mines are not deeper than 100 feet, though a few go as deep as 400 or 500 feet. In a few mines steam pumps and hoists are employed, but as a rule the mining methods are still crude, the acme of mechanical ingenuity being reached in a windlass operated by five or six men for hoisting the graphite in a sort of tub. The workmen usually ascend and descend by means of rough wooden ladders, tied with jungle ropes, and rendered exceedingly slippery by the graphite dust and water.

The mineral as it comes from the pits is conveyed in bags to a dressing shed, where it is picked over and the impurities reduced to 5 or 10 per cent. It is then packed in barrels for transportation to Colombo or Galle. At these ports it is unpacked and submitted to further treatment known as "curing." The graphite merchants have fenced yards or "compounds" for the final preparation of the graphite for the market. The large lumps and the screened pieces are broken with small hatchets by Singhalese women to remove the coarser impurities, such as quartz, and are then rubbed by hand on a piece of wet burlap, and finally on a piece of screening to give them a polish. Finally, various grades coming from several mines or differing in size or texture are blended to meet the requirements of purchasers.

The poor material is usually beaten to a powder with wooden mauls or with beaters shaped like a rolling pin and is then sorted into different grades.

One of the most important uses of graphite is for lubricating. The addition of graphite to oil results in a lower frictional resistance than would be obtained by the use of oil alone. The quantity of oil required for a given service is also reduced and a lighter grade of oil may be employed without decreasing the quality of the lubrication. A small quantity of graphite only is required, and the benefits derived from its use persist long after the application has ceased. Both the amorphous and the crystalline varieties of natural graphite are extensively employed for lubrication.

The use of graphite in the manufacture of pencils is probably both its oldest and its best-known application. This industry in Germany and England is several centuries old, and many of the modern factories manufacture hundreds of varieties of pencils, yet the percentage of graphite used for this purpose is not large, being undoubtedly less than 10 per cent. of the world's production, and one authority estimates it as low as 4 per cent.

The manufacture of artificial graphite is conducted by means of the electric furnace, an anthracite coal carrying small amounts of evenly distributed impurities being the material from which the ordinary grades are made. For obtaining the purest grades of graphite, petroleum coke is substituted for anthracite. The process for the manufacture of graphite was patented in 1896 and its commercial development has been so rapid that at present the output of artificial graphite in the United States is greater than the whole domestic production of natural crystalline graphite.

WOOD PAVING BLOCKS.

Consequent upon several articles appearing in the Weekly Report of the Department of Trade and Commerce relating to the opening in Great Britain for Canadian wood paving blocks, the commissioner interviewed the Secretary of the Highways and Paving Department of the Manchester Corporation, and the following information was obtained, viz.:—

"The area of wood block paving laid in public streets in Manchester is 37,634 square yards.

"Nearly the whole of the above paving is laid with Australian hardwood, Karri and Jarrah; the remainder is creosoted English beech.

"Wood paving is not considered suitable to the traffic of Manchester, and team owners strongly object to it. It is a costly pavement to lay and maintain and in consequence of these objections it has been laid only in front of public institutions (hospitals, schools, &c.) and in places where applicants have paid the cost of laying it.

"There is no prospect of an increasing trade in Manchester. The sizes of blocks used are 3 inches wide, 8 inches or 9 inches long, and 4 inches or 5 inches deep for Australian hardwood, and 6 inches deep for beech. The Australian blocks are not specially treated, but the beech is creosoted.

"A new length of wood pavement, requiring about 50,000 blocks, is about to be laid opposite a school, and creosoted deal blocks 3 inches wide, 8 inches long and 5 inches deep are specified for the work. The blocks will probably be Baltic timber, and the creosoting will be carried out at the place where the blocks are sawn, i.e., probably at the port of entry.

"Prices for delivered into Manchester vary from £6 to £8 10s. per thousand blocks, i.e., deal blocks."

STREET CLEANING AND REFUSE DISPOSAL.*

By F. W. W. Doans, City Engineer, Halifax, N.S.

In this age, it is admitted generally that sanitary science and public health have made such rapid progress as to become a part of the order of every careful person's life.

Public health and sanitary science have many and varied phases of approach. The medical officer keenly dissects from week to week the vital statistics of his district, for by so doing, he is enabled to discover the cause of death and disease, together with the locality where such are especially prevalent.

The measure of success which the sanitary inspector meets in the performance of his detailed work among the people often ranks with the diligence with which he applies preventive measures. "Prevention is better than cure," and the most eminent scientists and medical men of the day are ever striving not only to "cure" disease but to educate the community in the best methods which may be applied to "prevent" disease.

When disaster overtakes a citizen through a defective sidewalk, street or sewer, woe to the official who knowing of the defect, failed to remove the danger. His negligence will cost the town many dollars and may cost him his position, and his family bread and butter. Nay, more, it may cost a human life. Is not the man equally negligent who, knowing the danger to the health of his fellow-citizen and knowing also how that danger may be removed, makes no effort to give his fellow-man the benefit of his knowledge.

The foundation and the most important feature of sanitary science, is "scavenging." Sewers and water supply are secondary considerations if scavenging is neglected.

During the last century, our cities and towns have become congested areas, densely populated, and each producing a vast amount of filth in its midst. Irrespective of the many perhaps at present unavoidable unsanitary areas in almost every city and many towns, there will always remain to be dealt with the natural filth products from the population and business connected with all cities and towns.

It is because of this latter factor more especially, that within the last quarter of the century there has been brought to the front that great preventive science for the suppression of the cause of diseases, "scavenging," as applied through the machinery of a scavenging department under the control of a superintendent with scientific knowledge.

A few years ago this department was created in some of the larger cities when it was regarded as a luxury, but to-day the smallest town realizes that something similar is an absolute necessity. Why? Because it has become recognized generally that filth and noxious refuse in or around the centres of communities has more to do with the creation of disease than any other evil that exists. Each town has its health officer, and if the town itself does not attend to the scavenging, the health and town authorities make sure that the individual householder does it in a sanitary manner.

The working population have to live near their work and this work is in the town. It is here that the land becomes expensive, building costly and labor at the highest rate; consequently the rental values are forced up to such an extent that the smallest possible living and sleeping accommodation has to suffice for a man and his family. Very often when work is not plentiful or wages low, or the offspring many, the accommodation has to be kept within very narrow limits.

*Paper read before the Union of Nova Scotia Municipalities, Aug. 22nd, 1912.

The people who are tied to the town and more especially the slum area, have neither time nor thought for public or even personal health. The insanitary conditions of their district and its surroundings have become second nature to them, and if they think of them at all, they resign themselves to the conclusion that it is a penalty attached to their station in life, and must be endured.

It is here that scavenging can work wonders. This science properly applied, cleanses the streets, purifies the air these people breathe, the houses they live in, the shops they work in and the yards and recreation grounds (too often the streets) their children play in.

The principal that should control every scavenging department is to provide such measures as will enable it to get in touch with all the filth and refuse as soon as it is created and to keep hold of it until it is permanently destroyed. This immediate action will lessen the danger of it becoming disseminated. Dirt and refuse upon the roads, streets, or in the back yards of dwellings cannot be said to be under effective subjection. It is so only when it has been collected, stored in some suitable receptacles (whether it be a garbage cart or a sewer) and is on its way to final sanitary disposal.

There is no section of municipal work under the public eye so persistently as that of street cleaning. The public watch every movement and are prompt in lodging their complaints. The work is one which deals wholly with dirt in one form or another, and is always objectionable and an ever-present asset to the fault-finding taxpayer. Sometimes the objector has good grounds for complaint, consequently the object of any system of cleaning should be to remove the cause as rapidly as possible and with the least amount of inconvenience to the citizen. The object of street cleaning should not be to obtain a favorable appearance only, but to insure sanitary conditions.

Street sweepings consist of the waste products of hundreds and thousands of human beings and animals and include the constant wastes that are being thrown off by the industries in our midst, the debris caused by the wear and tear upon the road surfaces, the dust and dirt from the pulling down or repair of buildings, soot and fine ashes from hundreds, perhaps thousands of chimneys, twigs, bark, and leaves from trees, pollen seeds and spores of plants, the expectoration from human beings, the excrement and urine of dogs and horses, and the leakage of the contents of loaded vehicles both in transit and while loading and unloading.

Even the scavengers add very materially to the filth of a town. The horses contribute droppings and urine and the carts are sometimes so imperfectly suited to the duty they have to perform, as to distribute in part the filth they are supposed to collect.

The streets of a town are the avenues over which its produced filth has to be carried and each receptacle deposits its quota on the road as it journeys through.

Shopkeepers sweep out their collection of dust and dirt and housekeepers shake their mats on the highway to make a further addition to the miscellaneous accumulation of filth that finds its way into the streets and pollutes the air. This custom should be prohibited and each such offender should be obliged to dispose of refuse in such a way as will not menace the health of his neighbor.

If the public were only educated in these things and taught what not to do, many lives might be brightened and lengthened. As conditions now prevail we inhale particles of filth which are being continually stirred up by passing traffic. Our food and even the liquids we drink are affected. So penetrating is the action of this street filth, that it discolors our clothes and body, blackens our buildings and doubtless tends to lower vitality.

Now what do we do with this filth? The custom in most towns has been to use it to fill up low places in streets and sidewalks in the suburbs, and low ground elsewhere. It is absolutely necessary that stringent regulations should be made and carried out under which street sweepings should not be deposited on roadways or sidewalks to make a wearing surface. On the roadway, passing wheels fling its fine particles into the face of pedestrians and from the sidewalk it is carried on hundreds of boots into the home. It should be used at finished grade only for the boulevard part of the sidewalk and should be covered with a thin coat of good soil and sown or sodded as soon as possible after it is deposited. On the travelled part of the road or sidewalk it should never be deposited except to fill up below grade and then only when it can be covered with good clean material. In all towns there are streets which require thousands of loads to fill them up to passable condition. Thousands more may be disposed of on the town property and when such town places of deposit are exhausted there are many private properties on which there is low ground to be filled up.

The deposits removed from the catchpits should be used exclusively for the redemption of waste land, but no such disposal of catchpit or street cleanings should be permitted except by permit from the local health authority. A record should be kept of such dumping grounds. The date and character of the deposit should be recorded and no permit should be given for the erection of a building on such made ground until the health authorities are satisfied that nature has rendered the foul matter harmless.

In Halifax for some years the ashes collected by the city scavengers have been used to fill up low places in streets and sidewalks. Recently nearly all such available material has been utilized for sidewalk repairs except that in the summer it is used as a frost cushion under concrete sidewalks. During the past year the City Health Board has protested against this practice, on the ground that outbreaks of such diseases as scarlet fever and diphtheria have been caused by it. Whether or not their contention is correct, I am not prepared to express an opinion to-day, but it cannot be denied that the danger is possible.

It is claimed that householders empty sweepings into the ashpan and not into the stove. Although this is done in violation of the regulations of the Health Board, it is by no means an easy matter to prevent it. Frequently the kitchen maid finds it much more convenient to empty the dustpan into the ashes than to remove for that purpose the pots and kettles that cover the fire. The dust and dirt particles which may include the scarlet fever carrier, pass under the scavenger's eye without detection and consequently the regulation prohibiting the removal of ashes mixed with any other matters fails to protect.

Another objection urged is that householders expectorate in the ashes. I must confess that I have not been convinced that this practice is so dangerous as the deposit of sweepings, yet while there is any danger it should not be defended. It is not desirable to encourage such a custom, yet next to the fire, the best spitoon for any householder who cannot afford a cuspidor, is the ashes.

By the time the ashes are turned out of the pan into the barrel, turned out of the barrel into the cart and turned out of the cart on the place of deposit, the sputum is well covered with ashes and is not such a menace to health as it is when deposited on the dry impervious pavements where it can dry up and blown about. The ashes contain carbon, charcoal and recalcined lime which are deodorants and disinfectants. It is doubtful, however, if the natural process of humification becomes active in ashes as soon as deposited.

The natural soil is primarily derived from the subsoil which may itself be regarded as the weathered portion of the underlying soft or hard strata. Science has taught us that the upper layers of the soil are teeming with forms of organic life whose hunger is inexhaustible and whose power of absorption is so active that anything that is even thrown on the surface of the ground speedily disappears, and whether animal or vegetable, becomes humified and so incorporated with the soil as to become actually indistinguishable from it.

In time the objectionable matter in the ashes would undoubtedly be reconstituted into harmless mould by the action of micro-organisms and earth worms. The doubt, however, respecting what may happen in the meantime, prohibits us from defending the general use of such ashes in repairing sidewalks in the neighborhood of residences. "Separation of ashes from all other refuse under whatever system of collection, is always more or less imperfect and incomplete. Some house or store dirt will find its way into the receptacle intended only for ashes, and house dirt is peculiarly exposed to infection and is doubtless often really infected dirt. Hence it follows that not even ashes can be regarded as certainly free from infection, while garbage must be recognized as peculiarly exposed to it. There is one class of ashes which is so little exposed to infection as to belong in a group by itself, and that is the ashes from factories and other large establishments into which food does not enter.

It would be safer to dispose of the house ashes in the same manner as suggested for street sweepings and the same precautions should be taken by the health authorities respecting buildings on such deposits.

The best method of disposing of the house garbage cannot be determined so readily. A brief statement of the problem with an outline of general methods adopted for its solution may be of timely interest.

In Minneapolis the citizens are required to drain off all moisture from garbage and to wrap the solid in paper before putting it in the garbage barrel or can. If the collector reports to the scavenging department that the garbage is not properly drained and wrapped in paper no further service is rendered until the rule is complied with. If the householder then fails to care properly for his garbage or have it cleaned up, he is brought into court and fined.

It is claimed that the drained garbage will neither smell badly in hot weather nor freeze and stick to the can in cold weather.

Under existing conditions in almost every town, the can or the barrel is frequently a greater nuisance than the garbage itself. In primitive days, the Indian when the offence from the waste product of his house-keeping became too noisome, moved away, but in our day and generation we remove the garbage and keep the odor. With the presence of heat, moisture and flies, garbage very soon becomes a foul, maggotty, fly-breeding mass of putrefaction.

In the humble opinion of the writer, the Minneapolis regulation is admirable, although it may be a half measure only. A by-law requiring the draining of garbage is a good regulation but only half as good as it would be if it provided for burning in the kitchen fire after draining.

At a house in Halifax, which I visit frequently, although it has been occupied for over a dozen years, not one ounce of kitchen garbage has been removed from the premises by the city. All garbage and other combustible refuse is burned in the kitchen stove, the burning being carried out when there is a good bright fire. A removable strainer basket is kept in the corner of the kitchen sink. It costs 50c. and will last for years.

Peelings, the scrapings of plates from the table, porridge, soup or vegetable pots, pans, &c., leaves from the teapot, sol-

ids in the dishwater after washing, all go into the strainer in turn, and shortly afterwards into the fire. Fat skimmed from soup, gravy, &c., is cooled in a cup or saucer and then burned. Bones meet the same fate. There has never been a garbage can about the premises nor has one been needed. The only refuse which requires removal is bottles and cans.

As a result of practical experience, therefore, it is claimed that a by-law compelling householders not only to drain their kitchen garbage but to burn it, would be a great improvement on the draining alone.

It would not be a panacea, however, for all garbage ills. In summer, especially, in some houses the cooking is done on oil or gas stoves. Hotels and boarding houses have too large a quantity of garbage to burn, while some means must be provided for disposing of the garbage from grocery, provision, fruit, meat and fish stores, and many other properties where there are no fires in summer.

The most important part of this problem which we are called upon to solve is the method of final disposal. When a town has advanced sufficiently in population and public spirit to warrant a co-operative effort to handle and dispose of its household waste, the method of disposition invariably adopted in the first place is to gather all the refuse which would create a nuisance and be a menace to health at the individual residences and haul it all to one spot where it is dumped. It will be admitted readily that this method although so widely used, does not really dispose of the nuisance. It simply changes its location, and as the town extends, new dumping sites have to be found, with the added expense of a longer haul in order to place the danger at a more or less safe distance. It is questionable, however, whether there is any safe distance within cartage limits of a town.

With our present day knowledge of the causes and dissemination of disease, two minutes thinking should convince anyone that to collect decaying and putrid vegetable and animal matter and spread it out in the open atmosphere is unsafe, insanitary and unscientific.

A visit to a refuse dump will show it to be a breeding place for flies, rats, etc., and a source of offensive unwholesome odors, which are carried by the wind for long distances. Flies from such a place may be expected to carry disease into any residence they may enter. The danger to public health is further increased by the sorting over of the refuse by men and women and boys, who find articles which they consider of value. The fact that these articles have been in contact for hours, perhaps days, with the mixed refuse and garbage, together with the fact that the articles are not likely to be free from filth and disease germs themselves, emphasizes the risk of conveying these cullings back again to the town as carriers of dirt and disease germs.

The disposal of garbage and refuse in a manner conforming to sanitary law, is becoming a matter of vital importance and should receive the immediate attention which so important a factor in the welfare of the town deserves. It is most essential that adequate means be provided for the efficient disposal of all decomposing refuse, including dead animals and night soil. Sanitary authorities agree that the complete destruction of garbage or a complete change in its characteristics is the only solution that will satisfy sanitary requirements.

There are only three other methods of disposal which give any measure of efficiency—dumping at sea, the reduction method and incineration.

Dumping at sea is not only fully as expensive as burning, but where practised, is found to be very objectionable, even when the garbage is carried twenty miles out to sea, and is being abandoned by all progressive towns where it has been in use.

The reduction method which consists of passing the garbage only, through a digestive process and extracting its oils and grease, is not popular for the following reasons, namely, that it is expensive to install, it is very difficult to carry on the process without causing a nuisance by offensive odors, it deals only with the garbage, and some other means must be provided for disposing of the night soil and remaining refuse. Separate collections must be made and the town must compete in the open market to sell its grease and tankage. In a few towns night soil is disposed of by dumping into large intercepting sewers. It must be done in an enclosed chamber and under town supervision. The location must be chosen where an abundant supply of water is available and the carts used should be of the latest design.

The most successful means of disposing of town wastes is by incineration.

Furnaces are in use to-day in many towns having a population of only a few thousands and are solving the refuse disposal problem satisfactorily and economically. Time will not permit a description of the method employed.

Inquiries from Windsor and other members of the Union prompted me to prepare the foregoing information in the hope that it might make investigation easier for municipal officials who are convinced of the necessity for some improved method of refuse disposal.

FOREST RESOURCES AND MILLS OF NEWFOUNDLAND.

Reporting on conditions in Newfoundland, United States Consul James S. Benedict, of St. Johns, says of the forest resources and growth of the paper mills during 1911:—

"The resources of the forests are a steadily increasing factor in the development of Newfoundland. During 1911 there were fifteen lumber mills working under license, and 271 fishermen's mills without a license. The latter are permitted by the Government to operate for the sole purpose of supplying the fishermen with material for the construction of their buildings, vessels, etc. The output of the mills for the season amounted to 53,187,000 feet, as against 45,000,000 feet for 1910. The pulp wood cut amounted to 100,000 cords, as against 30,000 cords during the previous year. The men employed in the woods numbered 3,715 and in the mills about 1,500. For the fiscal year 1911, 6,085,000 feet, valued at $125,279, were exported, as against 7,707,000 feet, valued at $144,666 for 1910. The export of laths amounted to 2,315,000 pieces, valued at $4,768, as against 4,868,000, valued at $9,646, for the previous year. The local building operations consumed the larger portion of the lumber and laths manufactured, and there is an increasing demand.

"The pulp and paper mills at Grand Falls and Bishops Falls got fairly under way, and the two companies exported 21,064 tons of news paper during the fiscal year 1911, valued at $943,699, and 27,177 tons of pressed ground wood pulp, valued at $251,048. For the last six months of 1911 the export value of the products of the two mills amounted to $1,136,109, and for the calendar year 1911 the estimated value of paper and pulp was placed at $2,250,000. The importance of the paper and pulp industries may be seen by the fact that the company at Grand Falls at present employs about 2,000 men in its mills and 100 to 200 more in loading vessels. The total wages paid amount to about $900,000 a year, and the mills, with the new machines installed, are expected to have an annual output of at least 35,000 tons of ground wood pulp and about 60,000 tons of paper. The company at Bishops Falls also employs a large number of men in similar work. At present it is at work on the extension of the pulp-making plant, and further extension within a year is contemplated for the manufacture of various grades of paper."

REPORT ON RAIL CORRUGATION.*

By Arthur Busse, Chief Engineer of Way Grosse Berliner Strassenbahn.

The investigation into the cause of rail corrugation which has been continued by this association during the past two years has brought out a number of facts which have been more or less new, as well as opinions of many of the member companies on this subject. Some of these follow.

The Amsterdam Tramways believes that for a given composition of rail the length of the corrugations will depend on the speed of the cars. This opinion, however, is contrary to that enunciated by this committee in its last report that the metal of the rails itself contains the germ which gives rise to rail corrugation. Moreover, we believe that such a theory would be difficult to sustain. In our reports of 1906, 1908 and 1910 we showed that corrugations on a railway over which cars were run at the same speed varied in length when measured at two neighboring points. These measurements were taken not only on straight track, but also at stops and stations. There was no relation between the length of the corrugations and the speed of the cars.

The Antwerp General Tramway Company has observed small corrugations on the heads of new rails, but it does not consider that these are sufficient to start real rail corrugation, and has found that after a short period of service they disappear and the surface of the rail in contact with the wheel becomes polished. It does not believe that the method of rolling causes corrugation. Thus it calls attention to the development of corrugations in cast-steel special work, even in cast manganese-steel frogs, as noticed by other companies, although such material never passes through a rolling mill. In this connection the committee might add that such corrugation has been noted in Berlin in a section of cast-steel rail laid in an experimental track by the Berlin Tramways. The depressions were slight, but were visible, and their origin, in the opinion of the committee, is attributable to the method of manufacture. Manganese steel in track is not immune from corrugation, as shown by the experience of the Berlin Elevated Railway. In Antwerp the company report that the rails most corrugated are those on the outside of long curves and grades. The corrugations on the up grades are spaced 7 cm. (2.8 in.) apart and on the down grades 11 cm. (4.4 in.) apart, whereas on straight track the spacing is usually 9 cm. (3.6 in.). For this reason the company does not think that the incipient cause of corrugation exists in the rail before it is put in service. The committee, however, does not agree with the company in this conclusion, because if the active agent for developing this incipient corrugation is the sliding of the wheels the different lengths on up grades and down grades can easily be explained. Those on the down grade should be longer and those on the up grade shorter than those on level track, and the average should be about half way between the two, as shown in Antwerp.

Another company in Berlin, the Antwerp Tramway Company, is inclined to adopt the theory that corrugation is the result of a cold rolling of the rails by the wheels, according to a theory advanced by Mr. Beaumont in Engineering for September 8th, 1911, but differs with the conclusions of that gentleman in believing that the movement of the metal in the head of the rail is toward the sides of the rail, and is checked on the inside only by the pressure of the wheel flange. This checking force is not continuous, but intermittent, as the flange strikes against the side of the rail, and the effect of these two forces, one vertical and one horizontal, is to produce nodes.

The Bamberg Electric Tramway Company has found corrugations in light sections of rail, but not in heavy sections, and thinks that the light rail is too light. But, as the committee has already shown on other roads, corrugations occur on certain sections of rails, but not in others of exactly the same section when both are exposed to the same traffic conditions.

The Bern Municipal Tramways reports that corrugation developed in track laid on a bridge on a base of concrete. In 1906 a wood flooring 3 cm. (1.2 in.) thick was placed between the rails and the concrete for a distance of 60 m. (200 ft.). Since that time there has been no corrugation on this section, although elsewhere on the bridge the rails have become badly corrugated. The management believes that an elastic roadbed will reduce the trouble.

The Berninabahn, in Switzerland, which believes the process of rolling to be the initial cause, cites among other interesting facts that a part of its system some time ago was operated by steam, and the rails on straight track of this steam road developed corrugations. Later, this line was equipped electrically, and during the past three years there has been no change in the conditions either for good or bad. Later, some new rails were installed in a part of the line on which no corrugations had previously formed, but they developed the trouble.

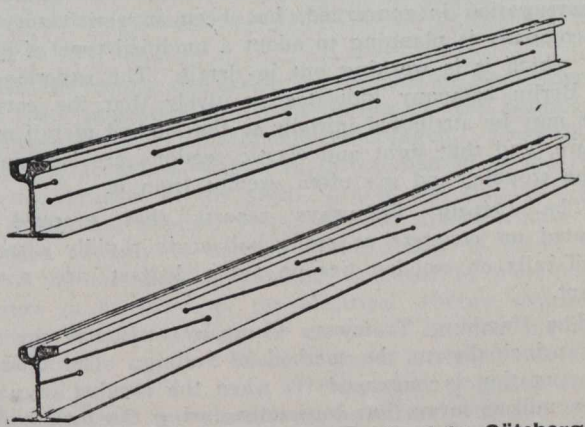


Fig. 1.—Rail with Slotted Web, Used in Göteborg.

The Municipal Tramways of Dresden has conducted a number of experiments, and is of the belief that corrugation is due essentially to the sliding of the wheels, although it may have had its origin in the method of rolling. In some recent track it laid alternate sections of hard and soft rail, the hard rail with an ultimate resistance to tension of 80 kg. per sq. mm. (114,000 lbs. per sq. in.), and the soft rail of 67 kg. per sq. mm. (95,000 lbs. per sq. in.). Corrugations appeared without an appreciable difference in both kinds of rail. It had been able, however, to reduce corrugations by laying rails on wooden ties. The conclusions of the Dresden company correspond with those of the committee, which, in its reports of 1906, 1908 and 1910, held sliding of the wheels to be one of the causes of corrugation, but expressed the belief that the initial cause was to be found in the method of rolling. The report from Dresden also tends to show that low-carbon rails, when used with low-carbon wheel tires, wear less rapidly than high-carbon rails with high-carbon tires. The Dresden company also found corrugation in its overhead trolley wire, which is of silicon bronze, confirming previous observations made by the committee.

* Abstract of a report submitted at the biennial convention of the International Street and Interurban Railway Association, Christiania, Norway, July 2nd to 5th, 1912, and recently published in the Electric Railway Journal.

The Geneva Tramway Company has experienced trouble with corrugation in the Phœnix 18-C rail, but not in the Phœnix 5-F rail or in a T-rail. The 18-C rail was generally laid in concrete and the T-rails are on wooden ties. The corrugations did not appear on steep grades, but on level track and slight grades. The committee thinks that the difference in corrugation between the 18-C rail and the 5-F rail may have been due to their difference in height and method of support, and its absence in T-rail to the different method of rolling this section.

The Göteborg Railway had experienced corrugation not only in rails, but in special work which is not rolled. It has also tried in experimental service some rails with slotted webs, as shown in Fig. 1, finding that corrugations disappeared in rails so treated. It believes that the corrugations observed on new rails have the same origin as those corrugations developed in service; that is, that the former are caused by the chattering of the rolls, and the latter by the vibratory wear of the wheels, but that the car wheels alone will produce corrugations, even on rails not initially so predisposed, and that the remedy is an elastic construction. The committee adds that the Berlin Tramways noticed some four years ago that very low rails do not seem to become corrugated. In consequence, it has, as an experiment, laid a section of track with a rail only 100 mm. (4 in.) in height. This rail is mounted in a concrete block. The experience with this section of rail, so far as absence of corrugation is concerned, has been so satisfactory that the company is planning to adopt a modified type of elastic rail, which it is working out in detail. The experience of the Berlin company indicates positively that the corrugations may be attributed initially to the method of rail manufacture, and that light and elastic sections are less subject to the trouble, and are often exempt from it.

The Leipzig Tramways reports that grooved rail mounted on concrete or stone ballast is rapidly attacked, and T-rails on wooden ties on stone ballast are entirely exempt.

The Hamburg Tramways Company attributes the difficulty principally to the method of rolling. The tendency to corrugation is increased (1) when the number of passes at the mill is large, but especially during the formation of the groove, when the change in shape of the metal is rapid, and also (2) when the tensile strength of the metal in the rail is high and the modulus of elasticity is small. The committee adds that its views coincide exactly with those enunciated.

The North Side Holland Traction Company lays stress on the necessity for elastic foundations. It notes that there is necessarily some slipping of wheels on the rails, both when they pass around a curve, and even when they move on a straight track, on account of the nosing of the cars. This slipping causes a vibration, which is transmitted by the wheels of the cars to the rails, and the company thinks that it is this varying pressure between the rail and the wheel which causes corrugation. An elastic track is better able to follow these different pressures. The committee adds that these theories have been outlined in the previous conclusions of the committee.

The Christiania Electric Tramways proposes to experiment with the plan of the slotted rail now being used in Göteborg.

The Tramway and Omnibus Company of Lyons is of the opinion that corrugation is due to the method of rolling and the lack of care taken in this operation. It has noticed corrugations on new rails from different steel mills. The company has never noticed corrugations on rails of the Marsillon type, of which it has a considerable number in use, and thinks that the trouble is due principally to the method of rolling the groove, and also to a lack of homogeneity in the metal employed, and that an effort should be made to overcome the differences in temperature existing between the different points of the same billet and the differences in pressure during the eleven or twelve passages which the wheel makes in the mill.

The Nuremberg Tramways states that on its system the rails which have been corrugated and afterward carefully ground down have developed other corrugations without exception, but in places different from those embodied by the first. It has found corrugations in T-rails as well as in grooved rails, but a longer time is required to develop corrugations in T-rails. In cases which are not favorable to the production of corrugation, such as short-radius curves and low speed, the initial corrugations have disappeared at the end of about three to six months. Light rails resting upon a basis of sand are immune, but heavy rails, even those rolled in the same way as the light rails and of the same metal, have been attacked. The corrugation has been particularly rapid in rails laid in a bed of sand on a foundation of ballast. Hence it does not appear that it can be avoided, even with an elastic foundation.

The Shanghai Tramway Company, China, has part of its system laid on ties with stone ballast, the other part on concrete. The former section has shown but slight corrugation and the latter a great deal, although the rails were secured from the same mill and rolled at the same time.

Edgar Rhodes, New York, calls attention to the Romopac duplex rail, which has not been attacked in Leeds, England, although ordinary rails under similar conditions have become corrugated.

Discussion by the Committee.—The committee in considering these reports says that in general they accord very closely with the opinions published in previous reports and the conclusions reached in other years by the committee. These conclusions were briefly that the factors causing corrugation were:—

(1) The quality of the rail. (Recent observations indicate that this is the principal cause of corrugation.)
(2) The use of hard tires.
(3) Too rapid braking at high speeds.
(4) Too rapid acceleration.
(5) Too high speeds.
(6) Nosing or side oscillation of the car, which can be produced by (a) the usual rigid mounting of two wheels on the same axle; (b) unequal diameters of the two wheels on the same axle; (c) difference in elevation of the two rails in the same track; (d) unequal division of the weight; (e) variations in resilience of the different springs of the same car; (f) play in the journal boxes; (g) irregularity in the gauge of the wheels; (h) irregularities in the surfacing of the track; (i) effect of torsion and distortion due to the method of driving the axle at one side; (j) axles out of square; (k) bad construction of the car; (l) too short wheel base.
(7) Large radius curves.
(8) Character of track substructure.

In the opinion of most of the companies of the association the nature of the metal in the rails (No. 1) is considered as the principal cause for corrugation, and the points mentioned under Nos. 2 to 8 favor the development of corrugation, but do not cause it. Many experiments have shown this. Thus, rail bought from different manufacturers, or from the same manufacturer, but rolled at different times, were laid without any particular order on the same trunk line, so that the operating conditions were the same, but it was found that their wear was entirely different. Those from one manufacturer or from one rolling showed a marked corrugation, whereas those from other manufacturers or from different rollings were not attacked. The railway companies and the manufacturers are equally interested in endeavoring to find a metal which will resist this wear.

Several years ago at the meeting of the Iron and Steel Institute of Great Britain Thomas Andrews called attention to the quality of metal in the rails. His analysis showed that there was often considerable free carbon, sulphur and phosphorus at certain points, and that this condition would not have occurred if the ingots had been allowed to stay longer in the annealing pits before rolling.

Mr. Peterson, manager of the Municipal Tramways of Dortmund, who has made an exhaustive study of this subject, has reached the opinion that conditions inherent in the process of manufacture, such as the rolling of the rail at too low a temperature and insufficient malleability of the ingot during the rolling, are the cause of the trouble.

An interesting discussion in Stahl and Eisen for March 7th, 1912, also appeared, by Karl Neu, on observations upon steel ingots during rolling. These observations are especially remarkable, as they contradict the general opinion on the processes of cooling of steel ingots. They were made on ingots, some of which had remained in the soaking-pit the usual length of time, and on others which had been in the soaking-pit for an abnormally short length of time only. In one case an ingot weighing 1,800 kg. (3,960 lbs.) was first cooled in the ordinary manner, and then placed in a reheating furnace, since no soaking-pit was available. The ingot was taken out after seventeen minutes and rolled down to a cross-section of 170 mm. to 200 mm. (7 in. to 8 in.). A notable thing was that after the first passes the ingot presented an expansion at the middle. While according to laws of solidification the metal should be purest on the outside and the largest cavities should develop in the interior, the opposite was found to be the case. A second ingot, 2,010 kg. (4,420 lbs.) in weight and 450 mm. x 450 mm. (18 in. x 18 in.) in section, was allowed to remain fifteen minutes in a pit which was not heated. Then it was rolled down in twenty-five passes to a section 175 mm. x 220 mm. (7 in. x 8.4 in.). Here again there was produced an enlargement which resulted after the third pass in a split forming in the direction of the rolling, and liquid steel ran out of the crack. The explanation suggested by Mr. Neu is as follows: When the central part of the ingot is still in a fluid condition before rolling it is naturally predisposed to be occupied by the impurities, although the exterior or that already solidified presents a great degree of purity. When rolled too soon the plastic material in the centre is forced into the outer parts of the ingot. This suggested to the author the desirability of leaving the ingot in the pit longer so as to improve the quality of the metal.

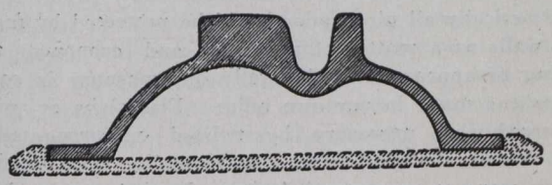


Fig. 2.—Rail with Double Web Being Tried in Germany.

L. Potin, another recent contributor to Stahl and Eisen, states as the principal cause of corrugation a too high temperature of the material when the rolling is begun and irregularities in the manufacture of the rail. He points out that when a rail is being rolled there are many abrupt differences between the speed of travel of the rail and of the rolls. When this difference of travel is large there is the drawing of the metal from behind the roll and a wave of the metal in front of the roll similar to that which occurs on a canal upon the passage of a boat. This produces a series of waves in the rail, and these will be particularly noticeable in the rolling of the head, where the cooling has been most rapid. He suggests that the way to avoid this trouble is to include in the specifications a limiting temperature for the last pass.

Dr. Poppe, of Breslau, disagrees with these conclusions, and says that it is erroneous to believe that corrugation began to appear only at the time when the mills commenced to roll rails at a high temperature. He also says that the soft iron rails of previous years were rolled much warmer than the steel rails employed exclusively today. He points out that the "creepage," or difference of speed between the rails and the rolls in the mill is much greater when the temperature is low. Consequently, corrugation ought to be less when the rails are hot, and not greater. He thinks that the length of corrugations depends on the speed of the cars and their weight, and hence it is unnecessary to impose special specifications on the rail-makers. These ideas ought not to pass without protestation.

G. E. Pellissier, in an article in the Electric Railway Journal for September 30th, 1911, believes corrugation due to a crushing of the surface of the rail by the wheel, and seeks for improvement in a different form of head. But this theory can hardly be admitted. If it was a question simply of superficial pressure, there would not be a difference in corrugation between rails rolled at different times, as has been observed, nor would there be corrugation of third rails, as shown on the Elevated and Underground Road of Berlin. Moreover, photographs of corrugated rail show that the corrugation extends the entire way across the head of the rail.

An interesting discussion on methods of measuring rail wear has appeared in recent issues of the Zeitung des Vereines Deutscher Eisenbahnverwaltungen. Theoretically, the ability to stand wear is in direct relation to the resistance to abrasion of the steel. Practically, the tests given are shock and rupture tests. Several methods have been proposed actually to determine the ability to stand wear. One is by an abrasion machine operated by electricity, a measure to be taken of the electrical energy required to remove a certain amount of material. Another method is to subject the rail to a blast of sand, a plan which should give good results if a basis of comparison could be chosen. A third method is to measure the effect produced by the rolling and the sliding simultaneously of steel wheels on the rail.

There is no doubt that the mills ought to endeavor to produce a metal more uniform as regards structure, density and durability. Railway companies at the same time ought to turn their attention to means of lessening the rigidity of the track structure, such as by using lower rails or a more elastic roadbed. By this means only can the trouble be reduced. As already cited, the plan of the Berlin Tramways is to use a low rail, and that of the Göteborg Tramways is to use the roll with a slotted web. Another effort toward introducing elasticity in the rail, shown on this page, has recently been patented in Germany. It has a double web, and compared with the centre web rail presents the great advantage of being rolled in such a way that at each pass in the roll the head tends to become more dense.

Conclusions.—The conclusions reached by the committee this year are not greatly different from those of preceding years. Nevertheless, there is added evidence that the primitive cause of corrugation is the method of rolling. Great interest attaches also to the use of elastic rails.

Appendices.—The report contains two appendices, one a report of some tests made by Mr. Peterson, manager of the Dortmund Municipal Tramways, on rolling lead ingots. These showed marked corrugation after they came from the rolls. The second appendix is a paper on the subject of rail corrugation read by Messrs. Schwartz and Cunliffe before the Institute of Electrical Engineers at London, March 18th.

PROBLEMS OF ROAD CONSTRUCTION.*

By Major W. W. Crosby.†

Possibly the problems of organization, administration, planning and recording might easily be considered to be included under the title of this paper. But to attempt to consider properly all these items would require the writing of a book, and even to attempt to touch on all of them in the limited time available for the speaker, would require so hasty a skipping "from crag to crag" as to result in almost entire waste of effort on the part of both the speaker and yourselves. Consequently, the speaker conceives it to be best to confine his remarks to details of actual work, out on the job itself.

Generally speaking, the first operations are those of grading and of installing the underground structures, such as culverts, abutments for bridges and underdrains.

If any clearing or removing of trees and old stumps is to be done it should be done promptly and thoroughly. Where practicable, the removal of trees should be accomplished by cutting off the roots around the tree a little distance away from the trunk and then pulling the tree over so as to rip out the stump proper. The roots thus left in the ground will do no serious harm unless within a foot of the road surface. It is sometimes the practice of the speaker to allow trees to be cut off close to the ground and the stump to remain, provided that there is to be not less than two feet of new fill between the top of the stump and the bottom of the surfacing. It may be trite, but it is at least safe to remark that in no case should a foreign stump be allowed to be placed in any embankment.

Underground structures, especially those that cross the road, should almost always be started as early in the proceedings as practicable. Such procedure not only insures their being out of the way of the later work and gives more opportunity to conveniently handle the public traffic generally to be provided for over a road, but also allows more careful construction and better results in the backfill. Only too often serious defects and extra expenses occur in the surfacing over culverts too recently installed before covering them. In this connection, the speaker will state that it is his practice to use vitrified clay pipe for all culverts 12 ins. to 24 ins. in diameter where the covering over them is not less than 2 ft. in depth and concrete boxes or cast iron pipe where the headroom or cover is less. He has experimented in a very few instances with corrugated wrought iron culvert pipes, but is as yet unconvinced of their general desirability. In his experience, he has had no difficulty with the use of first-class vitrified clay pipe even under heavy fills of, say, 20 ft. or more. Above 24 ins., the speaker prefers what is called "double strength" if clay pipe is to be used, but generally concrete boxes would be cheaper. Of course in the use of clay pipe, care must be exercised in the laying and backfilling, especially to prevent the presence of anything like a stone nearer the pipe than, say, one foot The speaker has seen a stone about the size of one's two fists forced by the fill above directly through the wall of an 18-in. clay pipe.

The bed on which a pipe culvert is to rest is a consideration frequently slighted. Only too often is it allowed to be of improper or uneven character. This is of especial importance where short length joints of pipe are used. A bed of sand or fine gravel on which to lay the pipe is often desirable and advantageous. Even oyster shells or crusher screenings may be used. The speaker had one case some ten years ago where a road crossed a bight of salt marsh by a pile trestle about 200 ft. long. It was proposed to fill in the space, instead of making the necessary renewal of the old wood work, and to care for a small stream crossing the road through the marsh by means of a double line of 30-in. cast iron pipe. The surface of the marsh was at about mean high tide and the marsh mud of unknown depth. Therefore, along the slight stream depression through the marsh, the speaker laid a bed of oyster shells—the cheapest available mineral material—about ten feet longer than the pipe and about 12 ft. in width. The shells were dumped from carts through the floor of the old bridge and spread out as necessary to probably an average depth of 2 ft. and with their upper surface level and just above high tide. The pipe was then laid on the centre of this bed and the filling over them placed. The results have been entirely satisfactory.

Especial attention to drainage is necessary in Maryland work owing to both the prevalence of loamy or clayey soils and to the "open" character of the winters. A great deal of "French drain" is used. The pipe is vitrified clay and generally 4 ins., though sometimes 6 ins. in diameter, with bell and spigot joints. Stone, gravel or shells may be used for backfilling with apparently equal results. We think it preferable to install the underdrain just ahead of the surfacing work in most cases.

Practically all pipe ends should be protected by masonry head walls as a matter of protection and economy, to say nothing of appearance. Generally our masonry is concrete on designs made in our own office. Flat slabs or girders, reinforced when necessary by twisted or corrugated steel rods, are usually sufficient. Occasionally, special circumstances warrant an unusual design. In such a case, bidders are given the opportunity to submit their offers with their own designs. These latter are checked by our office and the comparison made between the offer and the office plans and estimates so that a decision may be had.

Of course, the key to successful bridge work is in a proper foundation and this is a subject by itself. Not much more can be said here than that almost all kinds of foundations have their place and the real problem in each case is one of proper selection.

Preliminary to the placing of the surfacing comes the preparation of the roadway for it, or what is generally known as "subgrading." The speaker considers the matter of a proper subgrade one of the most important of all construction problems and regrets to be obliged to state that it seems to be one too often neglected. In his judgment more failures in the surfacing have had their rise in defects of the subgrade than in any other source. In fact, the importance of a proper subgrade can hardly be overestimated. A proper subgrade should be firm, even and as little susceptible to damage by water as possible. Gravel, preferably sandy or with no excess of clay, gives an ideal subgrade when properly shaped and rolled. Clean sand will furnish a most satisfactory one, though it may bring about some waste surfacing material. In many localities, neither sand nor gravel is available. Crusher screenings may be substituted with very satisfactory results. Some clays will make a very good subgrade, if not so wet as to be muddy or rubbery, nor so dry as to be dusty, provided the surfacing and underdrainage are so installed as to keep the clay in good condition. Other clays cannot be handled thus. The speaker has secured satisfactory results in some instances by the use of a layer of gravel, sand or screenings 3 ins. to 6 ins. thick immediately below the surfacing.

*Paper read before American Road Builders' Association, Nov. 14-17, 1911.

†Chief Engineer, Maryland State Road Commission.

Also, rolling a layer of stone into the subgrade after shaping it but before applying the first course of the regular surfacing, frequently relieves the defects in the subgrade. Another way is to prepare the subgrade by shaping and rolling as usual and then applying a first course of the macadam of special composition. That is, instead of using for this course, one size of stone, to mix with the ordinary No. 1 stone, say 50 per cent. of sand or screenings (for instance by running the screenings and No. 1 together from the screen). Then spread this mixture on the prepared subgrade, harrow it, and then roll. This has proved a very satisfactory solution in many cases where otherwise the failure of ordinary 8-in. macadam was almost certain. Probably the fine material in the No. 1 stone prevented the coming up of the subgrade material into the macadam and thus its destruction in freezing and thawing wet weather.

In passing, the speaker wishes to state that he considers that this matter of subgrade is only too often neglected in city work where a concrete base is to be used under the surfacing proper. In many cases too much dependence is apparently placed on this concrete base and even unnecessary expense is had for such concrete when by proper attention to the subgrade beneath it, not only better results, but also much saving in cost, might be secured.

In the reconstruction of old roads, it frequently happens that but slight changes of grade are desirable. Many of these old roads, such as the "pikes" have been "stoned" in the past and so massively, but withal so crudely, that they now present to travel surfaces that are solid beds of stone (mostly large) whose unevenness and roughness furnish the main, if not the only, reason for their treatment. Many of the audience will recognize readily a statement from the speaker to the effect that those familiar with such an old road are hostile to any idea of digging into or removing the old roadbed, if only for the purpose of breaking up the large stone. Nevertheless such a procedure is often the economical thing. If it cannot be done for any reason and the old stone bed must be allowed to remain, then the grades for the finished surface must be properly adjusted so as to provide at least a minimum thickness of new surfacing on top of the high points of the old stone. And this minimum cannot successfully be less than 4 ins. in the case of water bound macadam. With proper care in bituminous work it can probably be reduced to 2 ins. and possibly in some cases to even less.

Further, in such work on an old road, the depressions to be removed present a problem. It will not do to fill them with an absorbent material like clay or loam, and filling them with surfacing stone may be necessary even if expensive. Frequently, however, a cheaper roadside stone of inferior quality will answer. The same remarks apply to thin layers of material to come between the old roadbed and the bottom of the new surfacing.

In what may seem perhaps to have been rather a cursory way, the speaker has at last reached the problems of surfacing. And here perhaps a breath should be taken in view of the vast outlook.

Are there anything but "problems" in the subject of surfacing? And what a wide field of them, a field yearly becoming wider and more diversified, thanks to the activity of the proverbial American ingenuity, offers itself! To discuss, or even to review, a list of all the problems in this field, would be beyond the bounds of the present conditions, so the speaker will, in closing, merely mention a few salient points under the various kinds of surfacing on which he has convictions, or to which he feels it might be proper to direct your attention.

With sand-clay surfaces, it is important to get an intimate, even, and properly proportioned mixture of the sand and clay. With unscreened gravel surfaces, it is necessary that the gravel be free from stones larger than, say, a goose egg, and from an excess of fine material, i.e., either sand or clay. It must have, however, sufficient "fines" to fill the voids of the gravel stones, and preferably these fines should be of a highly cementitious character. If too weak in cementing qualities naturally, then something such as pitch, must be added to make up for the lack of bond among the round gravel stones and thus to remedy their tendency toward displacement under traffic, especially in very wet or very dry weather.

With screened gravel surfaces, when the correction of the sizing is had by the screens, the same remarks then apply. In some cases, screened gravel may be satisfactorily "bound" with limestone screenings. With marl surfacing the problem is to secure the necessary uniformity of the material and then to properly compact it in place. Plentiful watering and rolling is important.

With broken stone macadam, in the experience of the speaker, the most necessary, and at the same time, the most difficult thing to obtain is apparently the proper compaction or interlocking of the broken stone. Almost always the rolling of the different courses is less than it should be for the best results, and the deficiencies in rolling are attempted to be made up for by using the screenings too soon and too profusely. Another problem is the securing of the utmost degree of uniformity in the macadam layer as to thickness, evenness and homogeneity—no irregular depths of stone, no irregular thickness of courses, no pockets of material which varies greatly in size, etc.

And with all these surfaces just mentioned, the speaker, at the risk of repeating, must again call attention to the problem of getting proper rolling or compaction.

With bituminous surfaces, the main problem is perhaps again the securing of uniformity; practically all defects may be traced to the lack of it. The use of mechanical appliances of course always helps in securing regularity and homogeneity and generally tends to ecomomy as well. Their desirability is beyond question.

With pavements of various kinds, perhaps a general statement might be made that one important problem is to get them as dense as possible, that is, with sheet pavements, such as asphalt, bitulithic, concrete, etc., the mineral portion must be so proportioned that the voids will be at a minimum and the cement must then fill the voids. The other necessities of homogeneity, or uniformity and compactness also apply. With block pavements, the joints must reach a minimum and then be properly filled. The blocks themselves need uniformity and they must be placed evenly and solidly.

The speaker trusts he may have given an idea of the problems to be encountered in construction, if not a solution for all of them. In solving them, one and all, no factors will count more than carefulness and experienced intelligence.

The mines branch of the government department of mines states that its demonstration of the commercial possibilities of peat as a fuel in Canada has been successfully completed, and that henceforth the activities of the branch would be applied in another direction, probably the economic production and testing of fuel, concerning which the department already has a man in the west. The peat industry in Canada will now become a matter of private enterprise. There are two big plants under construction, one at Alfred, Ont., and another at Farnham, Que., which are expected to supply Ottawa and Montreal and possibly other cities with cheap fuel. Their capacity is about 30,000 tons per year.

ROAD WORK IN MASSACHUSETTS.*

The Massachusetts Highway Commission during 1911 was successful in applying some of the extremely heavy bituminous materials with a pressure distributor, the pressure being provided by an ordinary air pump operated by steam from the traction engine. This has been applied in grouting as well as in surface treatment, and it seems probable that in the future it may be possible to use some of the more lasting bituminous materials containing large quantities of asphalt by this method and thus secure more permanency in both construction and surface treatment.

During the year the commission used over 1,500,000 gallons of various bituminous materials in the construction and surfacing its roads, including various tars, tarvias and asphaltic oils sold under different contract names. The chemist for the state Board of Health, H. W. Clark, reports that from a laboratory point of view the materials were rather better during 1911 than formerly; that there was, however, altogether too much variation between the different lots of what purported to be the same materials, sold under the same trade name, and that altogether too many of them frothed badly when heated. This lack of uniformity in the materials is largely responsible for the fact that while some of the roads on which these materials were used are now in very good conditions, others are not. For instance, one asphaltic oil had a viscosity of 390, while an oil sold under the same name and used at another point had a viscosity of 540, and still another shipment had a viscosity of 590. Another asphaltic oil varied in viscosity from 240 to 340.

Some of the sections that were treated with oil or tar two or three years ago have had to be treated. On the other hand, some roads which had considerable automobile travel were treated with a surface coating of asphaltic oil three years ago and are now in very fair condition, nothing having been done to them since except to patch the holes.

It now seems to the commission that a surface coat of asphaltic oil would not prove to be economical or satisfactory on a road which has a large amount of heavy teaming though it is satisfactory, or has been up to the present time, on roads which have a large amount of high-speed automobile travel, with but few heavily loaded teams.

The state highway in North Beverly was given a coat of heavy asphaltic oil, one-half gallon to the square yard, in the summer of 1910, but it did not wear satisfactorily. It began to wear out first on the north side of the road, where heavily loaded ice teams travelled. The other side of the road, where they returned empty, remained in fairly good condition for a longer period of time. By the end of the season the oil was pretty well ground up, and was almost entirely gone over the travelled portion in the centre of the road. A large number of heavily loaded ice teams passed over this road daily, starting at the ice houses beyond North Beverly. This piece of state highway for many miles beyond, on the road to Newburyport, was treated in exactly the same manner with the same quality of oil. The whole road beyond the ice houses has been and is now in entirely satisfactory condition, showing conclusively that it was the teams cutting through the oil and down to the stone which churned it up into mud and then carried it off of the road. This year a reasonably satisfactory road was secured by applying a coat of one-quarter of a gallon of light asphaltic oil to the square yard. This light oil apparently fluxed back a part of the oil left on the road.

*Abstracted from the 1911 Report of the Massachusetts Highway Commission.

In general, other failures, not due to excessively heavy team travel, have been due to the qualities of the materials themselves, though in some cases they have been due to faulty application or to the fact that the road was not properly cleaned before the oil was applied.

It seems probable now that quite a few miles of the roads which had a surface treatment three years ago will only require extensive patching to carry them through another season, and that on others a little patching and a coat of one-quarter of a gallon of asphaltic oil to the square yard, instead of the half gallon which was first applied, will be sufficient to carry them through two seasons more.

COST OF ROCK BALLAST.

The following figures of the actual cost of putting stone ballast under track, taken from the Railway Age Gazette, are of interest to track men as illustrating what can be done in this work with a good organization, where attention has been given to a careful planning of details. This work was done on a heavy traffic line where it was necessary to pass a large number of trains daily, the total raise amounting to about 10 in.

Number of yards	58,883
Digging out, unloading, putting under and dressing up	$ 7,763.40
Labor cost, per yard	$0.1318
Stone, 58,883 cu. yds.	$30,619.16
Digging out, unloading, putting under and dressing up	7,763.40
Engine service	2,385.00
Stone inspection	222.00
Total	$40,989.56
Cost per yard	$0.696
Putting in 9,310 ties, putting on 8,400 tieplates, gauging	$ 893.76
Cost per tie	$0.096

REGULATION OF ST. JOHN RIVER.

A system of storage dams and other devices for regulating the flow of the St. John River is the principal recommendation by a board of consulting engineers to the International Commission, appointed some time ago to remedy conditions which now obtain. About a million dollars will be needed for the work, the expense of which will be borne jointly by Canada and the United States.

Beginning at a short distance above Grand Falls, N.B., where Canadian capitalists are now planning the erection of large pulp and paper mills, the river becomes international, and is the boundary between the United States and Canada. There have been recurrent difficulties in regard to the log drives, and at one time there were open hostilities, culminating in what is known as the Allejash War, when a dam was blown up by Canadian interests, and men employed by the American mill proprietors crossed the stream armed and threatened to shoot up those of the rival concern.

The commission appointed to enquire into the flow of the river, in order that uniformity at different seasons might be established, consists of M. G. Teed, K.C., and John Keefe, of St. John, for Canada, and Hon. G. A. Murchie, of Calais, and Hon. P. C. Keegan, of Van Buren, Me., for the United States. S. Jefferson Chapleau, of Ottawa, and H. S. Ferguson, of New York, were joint engineers.

ELECTRIC FRANCHISES.*

By L. A. Cannon, K.C., Alderman of the City of Quebec.

The word "franchise" has various significations, both in a popular and in a legal sense, and confusion often arises from a failure to discriminate in what sense the word is used.

Thus, in a broad and popular sense, it embraces the right of trial by jury, the right of habeas corpus and political rights of subjects and citizens like the elective or electoral franchise.

In a strict legal sense franchises are special privileges which are conferred by government on individuals, and which do not belong to the citizens of the country generally of common right or by the operation of the "common law."

Franchises are of various kinds and may include amongst others, the right to construct and maintain electric lighting plant, the power to exercise the right of eminent domain, and as such, are of paramount interest to municipalities. It must be noted that the use of the streets of a municipality for delivering electricity to the consumer is a franchise—Parnell v. McLean, 96 Md. 589, 56 Atl. 83. But the right to produce and sell electricity as a commercial product is not a prerogative of government but is open to all, and hence is not a franchise.

Corporations or bodies politic, or the privileges conferred thereon, are the most usual franchises. The right to exist as a corporation is itself a franchise, and in addition to this the different powers and privileges which may be exercised by the corporation are, as a general rule, also franchises, but a corporation may possess powers which are not strictly franchises, such, for instance, as powers which belong to individuals by common right.

There is a marked distinction between a franchise which is essential to the creation and continued existence of a corporation—a right to exist as an artificial being, a right conferred by the sovereignty of the state—and those rights subsidiary in their nature by which the corporation obtains privileges of more or less value, to the enjoyment of which corporate existence is not a prerequisite. State v. Topeka Water Co., 61 Kan. 547, 558, 60 Pac. 337. In People v. State Bd. Tax Comr's, 174 N.X. 417, 435, 67 N.E. 69, it is said: "The general franchise of a corporation is its right to live and do business by the exercise of the corporate powers granted by the state. The general franchise of a street railroad company, for instance, is the special privilege conferred by the state upon a certain number of persons known as the corporators to become a street railroad corporation and to construct and operate a street railroad upon certain conditions. Such a franchise, however, gives the corporation no right to do anything in the public highways without special authority from the state, or some municipal officer or body acting under its authority. When a right of way over a public street is granted to such a corporation, with leave to construct and operate a street railway thereon, the privilege is known as a special franchise, or the right to do something in the public highway, which, except for the grant, would be a trespass."

It is essential to the character of a franchise that it should be a grant from a sovereign power.

The grant of a franchise, in so far as it is ambiguous, is to be strictly construed against the grantee and in favor of the public, and nothing will pass unless it is granted in clear and explicit terms.

Accordingly some of the authorities lay down the rule that a municipal corporation cannot confer a franchise, grants or privileges by municipalities being regarded by some of the courts as mere licenses or contracts. On the other hand it is held in some cases that the state may indirectly grant franchises, acting through the agency of a municipality.

When the application of electricity for light, heat, power and traction purposes was first introduced, the promoters of these different public utility corporations were looked upon to a certain extent as public spirited citizens who were investing their money and energy for the benefit of their fellow citizens, in ventures of a more or less secure character. Hence the very general tendency to grant to these persons or companies extraordinary privileges for the use of public streets, for the laying of tracks or the erection of poles, and the stringing of wires. These charters granted, as far as the Province of Quebec is concerned, from the early eighties to quite recent years, are now the cause of difficulties and problems with which municipal administrations have to contend.

In the Province of Quebec, special legislation must be obtained to incorporate a company for the construction and operation of either an electric or steam railway; companies, however, for the purpose of manufacturing, selling and distributing light and power can be incorporated either under Letters Patent granted under the Federal or Local Companies Act, or by a special act of Parliament or of the Legislature.

As a rule, however, since the organization of this Union of Canadian Municipalities, through the efforts of our representatives and officers, the Legislature of the province, and also, I believe, the Dominion Parliament, have protected the rights of the municipalities as to the control of their streets.

In our province the Legislature has even gone so far as limiting the powers of the municipal councils to grant franchise. The action of the elected representatives of the people must in some cases be ratified—to have full force and effect—by a special direct vote of the electors.

As a general rule, in the Province of Quebec, whenever a municipality grants to any person, firm or syndicate the privilege, right or franchise, for over ten years, of running a tramway or introducing an electric or gas lighting system in the municipality, the by-law or resolution relating thereto, must, before having force and effect, be approved by the majority in number of the municipal electors who vote on such by-law or resolution. Such vote must be taken within three months after the date in which the by-law was passed by the council, otherwise the latter would be null and void.

It must be said, however, that in a great many instances, under the terms of their charters, companies have been exempted from the operation of this clause, which, in some cases involving a large expenditure of money, might prove repellent to capitalists.

I may be permitted, before closing these remarks, to expose in a few words the situation of the city of Quebec with respect to this question of electric franchises.

For the last few years the ancient capital of Canada has been handicapped by the effects of inflated public service corporation capitalization. Since the consolidation, under the guidance of a well-known Montreal financier, of the different companies who had been competing together to furnish traction, light, gas and power to our population, the price of electric light and power had become prohibitive for industries intending to establish themselves in Quebec. You must bear in mind that the capital stock and bonds of the Quebec Railway, Light, Heat and Power Company amounts to nearly $20,000,000, which is out of all proportion to the size of the community which it serves. Quebec and Levis

*Paper read at the Convention of the Union of Canadian Municipalities at Windsor, Ontario, August 28th, 1912.

have a population of about 100,000 and in order to pay interest on this capitalization, the amount to be levied from the citizens is probably heavier than anywhere else in Canada. Although the company have done their best to swell their income, the operating expenses are too heavy, and the directors of the merger have been compelled to pass dividends on the common stock. It has been figured that each family in Quebec would have to pay about $200 yearly for traction, electric light and gas, in order to warrant the payment of such dividend.

In 1910 the municipal elections were fought on this issue, and Mayor Drouin pledged himself to encourage competition at least for electric light and power.

A company, The Dorchester Electric, was organized with a capital of $1,000,000 to carry out this purpose, and, despite numerous difficulties which had to be overcome, was in a position to tender for lighting of the city streets for a period of ten years. This was a rather valuable contract and our call for tenders was framed in such a way that the interest of the consumer would be protected. The tenderer, besides quoting prices for the lighting of the public streets and squares, was called upon to bind himself to sell, during the period covered by their contract with the city, electricity to the public at a price not exceeding a certain maximum to be agreed upon. I will now quote some of the clauses which we have embodied in this contract and in the resolution granting them the right to enter the city of Quebec which had been previously given them. Our experience in the matter may be useful to younger municipalities who may have to deal with similar situations.

When the Dorchester Company applied for the authorization to introduce and sell electricity in the city of Quebec, we tried to ensure permanent competition by inserting the following conditions to prevent, as far as possible, the merger from taking control of the new company, either by buying a majority of the common stock or by obtaining their withdrawal from the field:—

(a) The said company binds itself not to cede or sell to any other company the powers conferred upon it by its letters patent, as regards the city of Quebec, without having previously obtained the consent of the city and the payment of a penalty of $50,000.

(b) If the company ceases to exercise its franchise in the present and future limits of the city during the ten years following the first of January, 1912, it will be subject to a penalty of $50,000.

(c) The company binds itself not to exact more than ten cents per kilowatt hour for the price of its electricity in the present and future limits of the city, and that the maximum rate cannot be changed without the consent of the city.

(d) The company binds itself to pay to the said city of Quebec as a penalty $1,000 for each infraction of the above conditions, save in the case where a higher penalty has been provided.

(e) Should the Dorchester Electric Company fail to carry out all or any of the conditions of the said contract, the city of Quebec shall have the right to purchase all the assets of the said electric company situated in the city of Quebec, together with all the power generated by the said company in the city of Quebec, at a price to be arrived at by a board of experts, appointed as follows: two by the said above-mentioned company, two by the city of Quebec, and a fifth by the four appointed by the above interested parties, or by a judge of the Superior Court, in case of disagreement.

After the company had secured their entry into the city, we thought it advisable to call for tenders for the lighting of the city streets and squares and municipal buildings fully a year before the end of the contract then in force. Our call for tenders contained the following clauses:—

(a) The tenderer will be required to mention the price at which he binds himself to supply the current, lamps and lamp renewals, including the cost or rental of the electrometer for residential purposes in the city limits, at a maximum price not to exceed so much per k.w. hour net, and the rate charged to remain in force till the expiry of the contract with the city.

(b) The tenderer will be required to mention the price at which he binds himself to supply the current, lamps and lamp renewals, including the cost or rental of the electrometer for commercial purposes in the city limits, at a maximum price not to exceed so much per k.w. hour net and the rate charged to remain in force till the expiry of the contract with the city.

(c) The tenderer will be required to mention the price at which he binds himself to supply motive force in the city limits, at a maximum price not to exceed so much per horse power net, and the rate charged to remain in force till the expiry of the contract with the city.

The Quebec Railway, Light, Heat and Power Company did not care to bind themselves under these clauses, and the Dorchester Electric secured the contract under conditions entirely satisfactory to the public and at the same time a fair price that will enable the company to make a reasonable profit for their shareholders in view of their moderate capitalization.

The merger has been charging 15 cents per kilowatt hour for current consumed by private customers, while the Dorchester Electric Company will only charge seven and one quarter (7¼) cents for the same service for the next ten years. The city will pay nearly 50% less to the new company than they are paying under the present contract, and for lamps of the newest and most improved type. This should bring the conclusion that, although the universal high cost of living has manifested itself in Quebec as elsewhere, Quebec will not have cause for complaint in so far as the electric lighting and power business is concerned, when the new competing service begins operation next fall.

We have also decided to begin the installation of a system of ornamental posts on the principal streets designed to carry clusters of five lamps. These poles will be supplied, erected and wired by the city, and we will endeavor before the expiration of the contract to build a complete system covering the whole city.

I am strongly convinced that all municipalities should at least, even when the idea of a municipal plant for the production of electricity does not meet with favor, become owners of a complete system of poles and wires to distribute electricity all over their territory. This would make the city much more independent when renewals of contracts come, would secure cheaper rates for public lighting and would also be in the interest of the companies. The municipality would simply have, like all other private consumers of power, to buy the current at the switchboard direct from the producer and use it in its own plant or distributing system.

The company, not having to take into account when preparing its tender, the heavy cost of erecting, for a period of five or ten years, a very expensive distributing plant that might prove useless if it failed to secure a renewal of their contract, would necessarily quote much lower figures not only for the lighting of streets and squares, but also for the current sold to consumers for ordinary commercial and residential purposes.

Thus we feel that, at any time, with a city-owned distributing plant, we will be in a splendid situation to municipalize the service if we deem it advisable.

There are many other aspects of this question of electric franchises that I would have liked to consider, but I must, under the rules of the association, close these remarks and thank you for your indulgence and kind attention, hoping that the foregoing may prove useful to some of our sister municipalities.

THE OVERHEAD PLANT OF A MODERN TELEPHONE SYSTEM.*

By Sergius P. Grace.

The public is ever wanting all poles removed and sees no reason why it should not be done, since the success of the underground wire distribution in the business districts of so many cities has been thoroughly demonstrated.

Now, all progressive telephone companies believe most thoroughly in underground distribution and are extending their underground conduits as rapidly as good economy for the benefit of both the public and the company will permit. Underground wires are cheaper to maintain than overhead wires, but the additional fixed charges brought about by the large sums required for underground work, make underground distribution prohibitive except in thickly settled business districts and along main feeder routes to the residence and other sections of the various cities.

In curve No. 1 are shown the varying costs between underground and overhead construction, from which it can be seen that not until we reach 800 to 900 pairs along a route can we truthfully say that underground construction in annual charges will be cheaper than overhead construction. The economical point will, however, vary in different parts of the country. Consequently the publicly despised pole lines must be brought into use on many streets and alleys of our various cities if we hope to give the public telephone service at a reasonable cost.

Those who are familiar with the congested and thickly settled cities of the East, such as Philadelphia, New York, Baltimore and Washington, where the entire city area covers a few square miles only, and, therefore, a large amount of underground conduits for distribution purposes is perfectly justified, perhaps do not realize the different conditions existing in some of the western cities, and particularly Pittsburg, where, because of the river valleys and the extremely rough topography of the surrounding hills, the city must necessarily spread over many square miles of area. Pittsburg, rather than being a condensed city, consists of a series of settlements, usually connected together along main business arteries through the valleys. For these reasons, we have had to confine our underground construction principally to the feeder routes through the valleys and rely upon side pole lines for distribution.

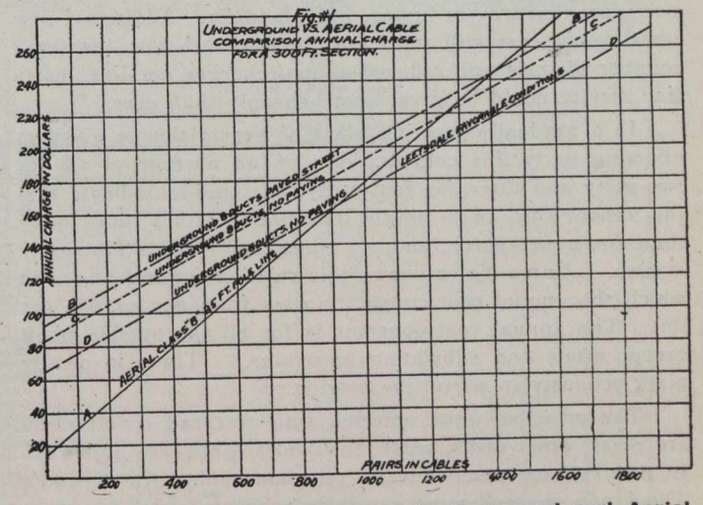
To have attempted a comprehensive scheme of underground distribution for each individual block throughout the city's territory would have been so enormously costly as to have financially embarrassed the company. Nevertheless, we have in Pittsburg about 110 miles of trench feet of conduit, in which is contained approximately 78 per cent of the total wire mileage of the city. You can see from this percentage, the part the main feeder routes play in the carrying of the main cables.

Realizing that in the present state of the art, we must make use of pole lines for distribution in cities, let us for a few moments trace the development of the pole line for telephone distribution service in exchange areas. The telegraph lines with high poles and bare iron wires on cross arms were developed before the invention of the telephone, and, with the introduction of telegraph engineers in the telephone business, it was only natural that the distribution lines should be patterned after the existing telegraph lines. Therefore, in the earlier days of distribution of telephone wires, wherever pole lines were used, it was the almost universal practice to erect very high poles, fifty to sixty feet high, and equip them with eight, ten or more cross arms, as the cases demanded.

These old-fashioned bare wire lines through city streets were very unsightly, and besides, gave an exceedingly large amount of trouble. In those days, the line trouble was very much greater than the switchboard or instrument trouble, and the bare wire distributing plant was usually considered to be the offender when any troubles occurred in the service.

When no more cross arms could be added to a pole line, recourse was had to short sections of cable, which were considered merely as auxiliaries to the bare wire lines.

In the territory of the Central District & Printing Telegraph Co., it was early seen that this type of distribution was practically impossible because of the winding streets,



Curve No. 1.—Annual Charges of Underground and Aerial Construction.

heavy grades, ravines and river valleys which are the accompaniments of a topographically rough country. Therefore, about 1896, to obviate these difficulties in the growing plant, the engineers of this company, principally Mr. Snyder and Mr. Donaldson, started a development and design of the aerial cable system of distribution which is standard to-day among all companies.

The development of these designs changed the entire appearance of the overhead plant. Instead of high poles, with many cross arms filled with bare wires, we find to-day low poles, usually not over thirty-five feet in height, with aerial lead cables attached near their tops, no cross arms, but tapping boxes at alternate poles, with arrangements for connecting the distributing wires to the buildings. Practically no wire is carried back and forth along the lead, since by the multiple tapping scheme, a certain number of pairs are brought out to the terminals on alternate poles, so that, even for party line connections, the service wires may be run direct from the terminal to the subscribers' premises. The aerial plant of the C. D. & P. T. Co. now represents 36 per cent. of the total plant investment, over one-third of which is cable.

Besides greatly improving the appearance of the overhead plant, and thus lessening the chances of public critic-

* Paper read before the Philadelphia Telephone Society and published in the Telephone News.

ism, this style of construction has greatly reduced the troubles from the wire plant. In studies which we have made of trouble in modern plants, we find about the following percentages:—

Switchboard trouble .....58 per cent.
Inside wiring and substation trouble....28 per cent.

This leaves only 14 per cent. as chargeable against the outside plant between the terminals on the main frame and the terminals of the protectors at the subscribers' houses.

In other words, the outside wire plant, which is exposed to all the elements, is responsible to-day for only 14 per cent. of the total service interruptions. This is a direct reversal of conditions in the older days, and perhaps the principal comment would be that there is no necessity for so much switchboard and substation trouble. The maintenance of substation apparatus costs as much as the maintenance of the entire outside plant.

There are a variety of opinions as to the economy of party line service from a plant standpoint, particularly in exchanges of 500 to 2,000 stations, in which places the outside plant is nearly always an aerial cable system. It has been said that any existing party line plant could be changed to single line with a comparatively small investment in cable pairs. This is true, but our exchanges do not grow that way in lumps, but gradually. Additional new lines would cost still more, or, because of the increased number of lines and reduced annual charges per line, party line service could be given more cheaply than ever.

In a gradually growing plant, if supervision is given to effecting party line combinations of an average of 1.8 for two-party and three for four-party, our studies indicate that the annual cost of a single line station is 1.5 times more than for a two-party and 2.3 times more for a four-party station. Curve No. 2 shows this relation for exchanges in which the annual cost constant varies from $20 to $32 per line. The annual cost constant is for all the outside plant except drops and substation apparatus. There is clearly plant economy in party line service.

The principal units entering into overhead construction are poles, cross arms, cable, insulators, hardware and wire. In this country practically all telephone poles are of wood. The kinds of wood most generally used are cedar, chestnut and creosoted pine. Each has its locality where it is most economical and most generally used. There is, however, an increasing tendency to make use of other kinds of timber, particularly after being given a creosoted treatment.

Steel poles have been used very little in telephone work, although extensively used by the railway companies for trolley poles. In large sizes they are many times more costly than wooden poles, and, besides, require constant upkeep in the way of painting. I feel sure that in the next few years there will be an increase in the use of poles made of reinforced concrete. A properly designed reinforced concrete pole should be sightly and provoke the least objections on the part of the public.

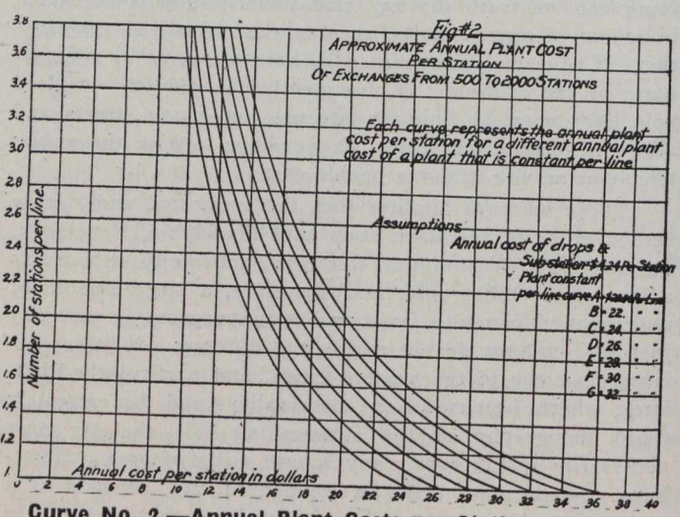
All over the country there are agitations to reduce the number of poles in the various municipalities. It must be admitted that this is a reasonable request on the part of the public, although we may say that perhaps the public has erred in permitting so many companies to build their pole lines in the streets. It certainly appears as the years go by we will be called upon to do an increasing amount of joint pole line construction with other companies.

A great step forward has been taken by the engineers of the American Telephone & Telegraph Co. in the working out of specifications for joint pole construction with electric light companies. Properly constructed, with electric light wires above the telephone wires, such joint pole line construction is safer to life and property than separate lines.

In many parts of the country, joint agreements have been perfected with the light companies, the standard specifications of the American Telephone & Telegraph Co. being substantially followed.

As a word of warning, I wish to say that unless we voluntarily go into these joint pole propositions, we will in a short time be facing regulation of our construction by the engineers of the various public service commissions, which is very likely to introduce special methods for each State. At the present time the Bell system is national in its scope and we are able to effect great economies in engineering and construction by uniform design. To have this great advantage in uniform methods set aside would be a decided step backward.

Of course, you have all heard of Pittsburg smoke and are willing to believe that Pittsburg is just as black as it is painted. It would be futile for me to argue with you on this subject, and tell you of the glorious sunrises I see from my home on Squirrel Hill, when Dooley is authority for the statement that in Pittsburg every other building is either a blast furnace or a Carnegie library. We do have smoke in our river valleys and blast furnace fumes in the air, which, aside from their esthetic effect, are decidedly destructive to our pole line hardware, such as braces, bolts, terminals, hangers and strand. For years we have had rigid specifications for this class of material and found it necessary to use only the best of galvanizing for protecting the steel.



Curve No. 2.—Annual Plant Costs per Station, Different Size Exchanges.

Unless one is thoroughly familiar with the principles underlying the protective action of galvanizing or zincing, when applied to steel, he will be deceived at the apparent long life of even defectively galvanized or cracked materials. Zinc is electro-positive to iron, and when a scratch or worn part goes through to the iron, there will be an electro-chemical effect set up which slowly consumes the zinc, but protects the iron from rusting; consequently for several months or years, the exposed iron or steel will show very little rust or corrosion until finally the surrounding zinc has been so thoroughly eaten away that it can no longer protect the iron electro-chemically, and then rusting will start at a rapid rate. This is why galvanized material that has stood up well for perhaps four, five, six or seven years, may inside of two additional years be completely rusted away.

Having heard so much about it, I know that you will be interested in an analysis of Pittsburg air made by Doctor

Phillips, of the University of Pittsburg. Doctor Phillips collected samples or rain-water at the beginning, the middle and the end of various showers. This water, having passed through the atmosphere, would naturally collect any foreign gases soluble in water and would also carry along with it any soot particles with which it came in contact.

The most remarkable thing about these tests, and the least expected, was the fact that rain-water collected, after passing through the Pittsburg atmosphere, contained no trace of sulphuric acid. There was, however, found a small amount of ammonium sulphate, showing that the nitrogen in the air had combined with the sulphur dioxide and neutralized it. The amount of carbon dioxide was only two-thirds greater than in normal air, such as is found in Northern Canada. Whatever nitric acid might have been generated had been converted into ammonia. The atmosphere seemed to be entirely free from acid; in fact, was quite alkaline. It was found, however, that there was an active corrosive agent in the Pittsburg atmosphere. This is the soot, which, being very porous, absorbs a considerable amount of sulphur, and when wet contains about two per cent. of free sulphuric acid. Apparently, then, the corrosive action in the Pittsburg atmosphere is largely due to the collection of soot upon the surface of the coated metal and the liberation of sulphuric acid during the rain-storms.

The recent introduction of loading coils in aerial toll lines has made it particularly necessary that the insulation of these lines be kept very high. This has led to the very careful maintenance of the right of way of the pole lines and the trimming of all tree limbs that might come in contact with the wires. Also on some of the longest lines, porcelain insulators, which have a higher insulation resistance during rainstorms than glass, have been used to good advantage.

In the Pittsburg district, where the toll lines traverse the river valleys in the neighborhood of the steel mills, we find it difficult to maintain a high insulation due to the accumulation of soot, and on a number of routes we have had the utmost difficulty in keeping the lines working because of the accumulation of iron ore dust on the insulators and cross arms. This dust is of a metallic nature and floats through the air because of slips which frequently take place inside the blast furnaces during the feeding.

For toll line purposes, where bare wire is necessary, the universal practice is to use hard-drawn copper, with the possible exception of certain rural districts, where it is certain that no very long distance calls will be made. Under ordinary atmospheric conditions, copper is practically indestructible. There is an authentic case of a sheet copper statute in one of the interior towns of France, that in 200 years has lost in thickness only 1/1000 of an inch. Copper wire in the Pittsburg district does not seem to deteriorate except in the vicinity of coke ovens, whose fumes contain the hundreds of coal tar derivatives.

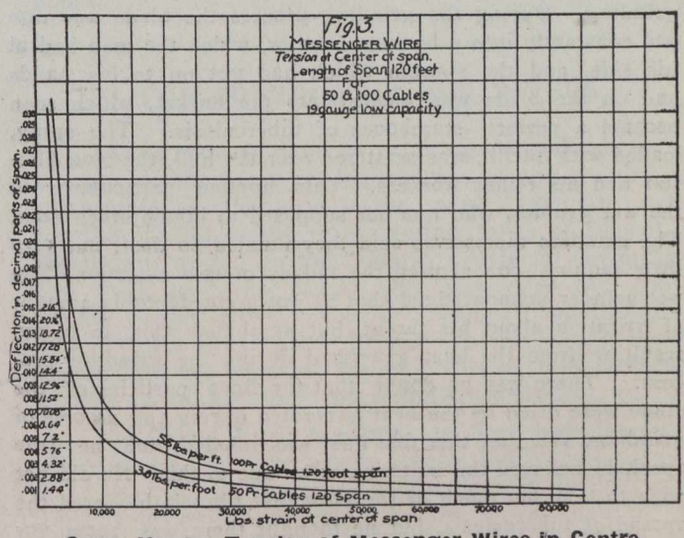
In some locations we have had to renew copper wires every three or four years. Iron wire is of practically no value in the Pittsburg territory except in the remote interior country sections. In exchange distribution, because of the introduction of the aerial cable system of distribution, there is very little need of bare wire for distribution purposes. There are a few places, particularly suburban districts, where bare wire on cross arms is more economical during the initial period than cable or insulated wire.

Generally speaking, the distribution in exchanges to-day is made almost entirely with cable and twisted pair distributing wires. There are many advantages in the use of twisted distributing wire, among which may be mentioned the freedom from trouble with electric light and power crosses. The twisted wire does not need to be strung on expensive cross arms, but can be attached, by means of small iron brackets and porcelain insulators, direct to the pole itself. The labor of stringing is very much less than bare wire, and the same thing may be said of removing the wire after it is out of service.

It makes a very convenient and economical type of unit construction, which can be used for establishing service prior to the time it is thoroughly demonstrated a cable will be warranted along the route. When the cable is placed the drop wires can be connected directly into the terminals, and that portion of the twist strung along the pole line can be taken down and used for other drop wires. The transfer expense is therefore small.

Until March, 1910, it was the general practice to use, for distributing purposes, No. 14 B. & S. gauge copper, rubber covered and braided distributing wire. This made a first-class installation, but the wire was needlessly large and contained more copper, rubber and braid than necessary. Since the drop wire is usually connected to a 22-gauge cable pair, it can readily be seen that No. 14 copper wire was used for strength alone and not for its conductivity.

For the past two years the practice has been to use No. 17 B. & S. gauge copper steel, rubber covered and braided distributing wire. This wire has nearly the same tensile strength as the old No. 14 wire, but because of its lesser



Curve No. 3.—Tension of Messenger Wires in Centre of Span.

weight per foot, has a much greater factor of safety under all conditions of sag and ice-loading. Its cost is about $25 per mile less than the old No. 14 wire.

While on the subject of rubber covered wire, I would like to state that a good rubber wire is an economical investment, whereas a poor rubber wire is the poorest kind of an investment.

During the early period of the introduction of the aerial cable system in our territory, we were particularly careful as to the quality of the rubber wire we purchased. As a result all of the earlier wire has stood up in practice exceedingly well and undoubtedly has had a life of at least ten years. As an argument in proof of this statement, I wish to give you tests we made on samples of rubber wire from Wheeling, W. Va., which we were positive had been in service for a period of ten years.

Except for a few spots where the wire was mechanically injured it was in fairly good condition and capable of giving several years' additional service. The rubber still had considerable life and, when the wire was subjected to a tank insulation test, showed an insulation resistance of 232 megohms per mile after an immersion of 18 hours.

(To be continued.)

HYGIENE OF THE STEEL TRADE.

Before the Industrial Hygiene Section at the Royal Sanitary Institute Congress at York, on July 31st, Professor J. M. Beattie (University of Sheffield) read a paper on the above subject, in the course of which he said that a great deal of attention had been centred on the dust problem, and much of the legislation relating to the industries with which they were dealing was concerned with the protection of the workers from dust inhalation. To his mind the much more serious problem, the prevention of infection with tuberculosis, had not received justice at the hands of factory inspectors and factory legislators. During a five years' experience in Sheffield it had been abundantly demonstrated to him that the cutlers and grinders die from tuberculosis, and not from non-tuberculosis fibrosis of the lung.

Professor Beattie exhibited a number of lantern slides, showing how dust blocks the lung tissue, and expressed the view that whilst the tubercle bacillus obtained an easy lodgment in these parts, yet its spread was hindered by the fibrous tissue. The means for the distribution of the tubercle bacillus were obvious to anyone walking through the grinding hulls. The men spat on the wheels in the trough in which water for the wet grinding was contained, and on their hands as they got renewed grips on the blade they were grinding. During the grinding process the blade was dipped constantly into a bucket of water, which the man had at his side, and the sputum which had got on to his hands and on the blade was washed into the bucket, which soon became a perfect storehouse of tuberculosis. The spray, loaded with bacilli, was scattered over the hull, the man himself and his fellow workers. This applied particularly to the wet grinder, who was not supposed to inhale much dust. The grinders themselves said they inhaled no dust, but very little inquiry soon showed the fallacy of this assertion. The wet grinder acknowledged that he got a considerable amount of irritation about his throat, but attributed this to fumes resulting from the heat generated during the grinding process. There was no doubt that the finer particles of the stone were dried by the heat generated during the process of grinding, and that this fine dust was inhaled, and he (the speaker) believed the irritation to be due to this. He did not wish to take too much of the view that fibrosis hindered the spread of tuberculosis, but he thought there was room for further investigation as to whether the inhalation of a mixture of dust and tuberculosis was not less likely to produce rapidly spreading tuberculosis than an inhalation of tuberculosis alone.

It is unnecessary to deal specially with the dry grinder and the cutler. It was unquestioned that the tuberculosis from one man might infect a whole workshop if that man's sputum was allowed to get mixed up in any way with the dust. In fact, the distribution was more easy with the dry grinder than with the wet. He would urge much more care in eliminating the tuberculosis from the workshop. So long as they allowed people infected with tuberculosis to work among their fellows, and at the same time did not enforce the strictest regulations to stop spitting, then all the elaborate precautions to minimize the amount of dust were only touching the fringe of the whole question.

THE SPOUTING OF CONCRETE.

For successful operation of the gravity systems for conveying and distributing concrete, one of the most necessary things is the proper mixing of the ingredients. In a recent issue of Chain-Belt some remarks are made on the above. Having given the proper proportions to the ingredients it is absolutely necessary that enough water be added to the conglomerate to produce a specific gravity such that the rock is held in suspension; the mixture will then flow like a thick gravy with no sign of excess water; in other words, it should have a saturated amount of water and no more. This particular mixture is surprisingly slippery and flows readily around all steel. It has an oily nature which is due to the cement.

In placing concrete by the gravity system there are three operations: The mixing of the ingredients, stone, sand and cement, in a suitable batch mixer; hoisting of the mixed concrete by skip to an elevated hopper; and the transferring of the concrete through pipes leading from this hopper to the point where it is desired to be poured.

The following general instructions for operating a spouting system may be of value:

1. Run about 10 feet of water in skip.

2. Charge mixers, using mostly sand with the cement and plenty of water.

3. Run up skip with water and drop at once, following up as quickly as possible with a charge of concrete.

4. Run the mixture so that it may have the consistency of a thick gravy, so that when it levels off the rock is seen held in suspension. If when dumped in the skip it stands up, it is too thick; if it levels off and shows one inch of water, it is too thin.

5. There should be a man in the tower to operate the concrete gate on the hopper to regulate the flow of concrete through the pipes. The stream should fill about one-third of the conveyor pipe and the charge should be so timed that the stream will be as continuous as possible.

6. The continuous and successful running depends on the uniform mixture. Be careful not to get it too thin. After a shut down of over ten minutes, flush the pipe by sending up ten feet of water in the skip.

7. At the end of the day's run clean out the mixers with two charges of water. Send these through the pipes.

8. All pipe joints should be oiled with thick grease so as to prevent sticking.

It is in general not advisable for any contractor to use the gravity system for the first time on a job of less than 2,500 cubic yards. However, it has been successfully used on jobs as low as 250 cubic yards. In these cases the apparatus was on hand and the men were acquainted with its operation.

LABOR UNREST STILL ON THE INCREASE.

Industrial conditions were seriously disturbed by labor disputes during July, the number in existence in that month being considerably greater than the number existing during June. The number actually commencing, however, during July compares favorably with that of the previous month. In all, forty-six disputes were reported to the Department, an increase of nine as compared with June, and an increase of twenty-eight as compared with July, 1911. About 17,000 employees were affected by these disputes as compared with 15,000 during June and 19,000 during July, 1911. A termination of the garment workers' strike in Montreal occurred during July, which caused a resumption of operations by more than four thousand employees after nearly two months of idleness. Few of the disputes commencing during July were individually of serious consequence as factors in disturbing industrial conditions.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD, MARINE AND MINING ENGINEER, THE SURVEYOR, THE MANUFACTURER, AND THE CONTRACTOR.

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Present Terms of Subscription, payable in advance

Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	**$1.75** (7s.)	**$1.00** (4s.)

Copies Antedating This Issue by More Than One Month, **25** Cents Each.
Copies Antedating This Issue by More Than Six Months, **50** Cents Each.

ADVERTISING RATES ON APPLICATION.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main **7404, 7405** or **7406**, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C Allum Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Business and Editorial Representative.

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Everything affecting the editorial department should be directed to the Editor.

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

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Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

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Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 23. TORONTO, CANADA, AUGUST 29, 1912. No. 9

CONTENTS OF THIS ISSUE.

THE DOUBLE-DECK STREET CAR.

An aid towards the solution of the problem of handling transportation in the larger cities of the States has materialized in New York and Pittsburg in the use of double-deck cars. These cars have been introduced almost simultaneously, and are now in operation. Their use in these cities will be viewed with considerable interest.

Their use is attended by many favorable conditions. The double-deck car takes only the track space of one car, but gives the seating capacity of two. At the times of congested traffic this is a decided advantage, in that it will allow the doubling of the number of cars on any one street. In England the double-deck car, or omnibus, has been used for a considerable period of time, but these cars are the first appearance on this continent. The operating expenses will be lessened by their use on account of only one crew being requird to operate the car.

If these cars are a success, as in all probability they will, no doubt their use will be taken up by the larger Canadian cities where congested conditions exist. Their use, for instance, in Toronto in the down-town areas would do much to relieve conditions during the rush hours.

THE CONTROL OF OUR RIVERS.

The increasing damage resulting from floods on the streams of the more settled sections of the country will necessitate, in the near future, some adequate action for the control of the water during times of freshet. A deputation waited on the Ontario Provincial Government last week to secure action with regard to the control of the Grand River. The deputation from the Grand River valley urged the Premier to initiate an investigation into the effect of spring floods on that river with a view to taking some preventative action.

The Grand River question has been brought to the attention of the Government before, but as yet no move has been made towards conducting an investigation. In this argument presented to the Government it was shown that not only could the damage by floods to a great extent be obviated by control, but that the in crease in the minimum summer flow as the result of storage would mean a considerable gain in horse-power on the existing water-power developments of the river, with the addition of new water-power possibilities. Water supply, sanitation and general benefit would be the result of securing a uniform flow on the river. The Grand River drainage area and the hydrographic conditions surrounding it appear to point to storage as the economic and feasible solution for the control of its water. Reforestation is of doubtful practicability in connection with this river.

The Premier seemed rather cool towards the delegation. His answer that the people in other sections of the province were troubled in the same way is quite true, and the subject opened up is a large one. Nevertheless, it is time that some action was taken with regard to the problem. Before any constructive work can be done it will be necessary to investigate the conditions existing, and this will take some time. It is desirable, therefore, that some immediate action be taken towards securing the necessary data, and it is hoped that the provincial government can see their way clear to provide the funds for an engineering investigation.

THE PANAMA CANAL BILL.

One more milestone was reached when the United States Senate two weeks ago passed the Panama Canal administration bill. This bill contains a provision exempting United States merchant ships from the payment of canal tolls, while foreign ships remain subject to them. That exemption is a direct violation of the Hay-Pauncefote Treaty, which was ratified in 1911. The bill was passed in the face of direct protest registered by the British Government and against public feeling in the United States as expressed by the responsible newspapers. We feel satisfied that the prevailing sentiment throughout the United States is against this action on the part of the Senate. It will have the effect of making nations dubious about trusting to the honor of the country in future negotiations. It is no light thing in international politics to repudiate pledges made by one responsible country to another.

Aside from the effects of this breach of faith on the part of the Senate, it is an open question whether it is good business to subsidize water-borne commerce. It is a well-known fact that water rates are adjusted to fall slightly below the rates of the railroad. The coast shipping of the United States, which is expected to benefit by the exemption of tolls, is well able to pay the same tolls as the ships of foreign register, and there is no reason why they should not pay these tolls to help cover the investment in the Panama Canal.

The western harbors of Canada have a great future ahead of them in the opening of this new avenue of commerce. Even if Vancouver is penalized to the extent of $1.25 toll over Seattle, there remains a great future for the port as a result of the opening of the Canal. It is pleasing to note that the Canadian harbors on the Pacific are being prepared for the greatly increased development to be expected in the near future. In this issue of *The Canadian Engineer* some details are given of the improvement to be made at once on the Victoria harbor. The Government is alive to the necessity for prompt action with regard to the development of the western ports.

DEVELOPMENT OF MONTREAL PORT

The Harbor Commissioners of Montreal have in view a comprehensive plan for the development of that port, a plan, in fact, which involves the expenditure of many millions and the practical transformation of dockage facilities. When the commissioners took office some years ago, they paid immediate attention to future requirements as well as to those of that time. As a result they had the engineers prepare plans which they expected would take a dozen years to materialize. These plans are gradually developing as the work proceeds.

Among the objects of the commissioners is that of reducing the flow of water which now meets the ships coming up the current in front of the city. For that purpose they have considered plans by which much of the water will be diverted between St. Helen's Island and the south shore. The reduction of the current in the upper part of the harbor and the possible changing of the inlet to the Lachine Canal are under discussion.

The commissioners may likely construct a bridge to connect the city and the south shore. The city end of this bridge would apparently rest upon the end of a new pier to be built outward from the city. The other end would rest upon the west end of St. Helen's Island. From there to the south shore, the work will be a simple matter. By following this route, the difficulty of raising the bridge above the masts of incoming steamers disappears, as the vessels do not proceed so far upwards from the sea. Residents both of Montreal and of the south shore welcome the announcement. No doubt street car facilities will be provided.

EDITORIAL COMMENT.

The Canadian National Exhibition is again in full swing, bigger and better than ever this year.

* * * *

Hamilton is up against the sewage disposal question. The city has grown so fast that the present methods of handling city sewage are considerably overtaxed. The city engineer has impressed on the council the necessity for prompt action. It is to be hoped that such action will be taken without the necessity of intervention on the part of the Provincial Public Health Department.

* * * *

The City Council of Kingston appear to know more concerning technical matters than their expert advisers. They have decided to enlarge the present steam plant in the face of the advice of their consulting engineers, who are strongly opposed to such a step. The education of our public men must be developed in the near future, if the public are to secure the economical spending of money for public utilities.

* * * *

The Medical Health Officer of Toronto certainly understands the art of procuring advances in salary to hold his employees. The civic position of epidemiologist has been created to keep one of the assistants in the Medical Health Department of the city. If the city engineers of some of our cities were as earnest in the securing of reasonable remuneration for their assistants, the engineering profession in Canada, as a whole, would be on a higher plane.

* * * *

During the progress of the inquest at the time of the Neilson building collapse at Toronto, we had occasion to refer at different times to the methods of carrying on the City Architect's Department. Since that time serious criticism has been levelled at this department from many sources. It is time that some adequate endeavor was made by the city officials to put this department in shape. The complaints of the structural engineers of the city justify energetic actions at once.

THE NEW TRANS-AUSTRALIAN RAILWAY.

The placing of contracts for the immense amount of materials required for the construction of the Kalgoorlie, W.A.-Port Augusta, S. A., railway has been delayed owing to a difficulty which had arisen between the Commonwealth and South Australia. The point in dispute was that of the land desired by the Federal Government, and this issue has now been settled by compromise. Tenders for 135,000 tons of steel rails and fishplates, 4,486 tons of iron dog spikes, 2,200,000 sleepers (reinforced concrete, timber or steel), and 1,384 pairs of wheels and axles, are now under construction. The total necessary expenditure or materials is estimated, approximately, at £2,500,000. It has been decided to call fresh tenders for 200 sets of points and crossings and 105 sets of trap points. While the State Government of Western Australia anticipates that the railway will require a large number of karri (timber) sleepers, it has not yet been definitely decided whether the sleepers will be of wood, steel or reinforced concrete.

NEW BREAKWATER FOR VICTORIA, B.C.

Plans and specifications for the construction of the breakwater from Ogden Point, Victoria, B.C., have been prepared by the Department of Public Works. Tenders will be received from contractors up to September 5th. The work is to be completed in three years. The specifications provide that the construction is to be commenced immediately that the successful tenderers have been notified, and must be proceeded with in such a manner as will satisfy the Department of Public Works that the whole work can be completed within thirty-six months from the date of notification of acceptance of the tender.

The breakwater will extend from Ogden Point for a total length of 2,580 feet. It will run 330 feet south and thence westerly 1,500 feet, and curve thence northwesterly 750 feet (Fig. 1). The plans and specifications provide for a rubble mound surmounted by a wall of mass concrete for the whole length, with heavy granite blocks on the seaward side.

This is the first part of the harbor works to be provided to properly equip the port of Victoria to handle the great shipping trade that will follow the opening of the Panama Canal. It will shelter five modern concrete piers to provide berthing space for twenty or more of the larger steamers. These piers will be equipped with warehouses, cranes and all modern facilities for cheaply and expeditiously handling cargo. Spacious basins will be provided between the piers, and when the whole scheme is complete it will offer a harbor second to none on the North Pacific coast.

The plans under which the breakwater will be constructed are shown in the figures, and indicate the character of the work. The rubble mound will be 64 feet in width at the line of extreme low water at the ordinary stage of the tide. From this elevation the mound will slope on the exposed side at an inclination of 1½ feet horizontal to 1 foot vertical, and the slope on the harbor side will be 1 foot in 1 foot. These slopes will be continued when the concrete, topping the mound, is completed. A core of quarry stones will be allowed to a height of 35 feet, with

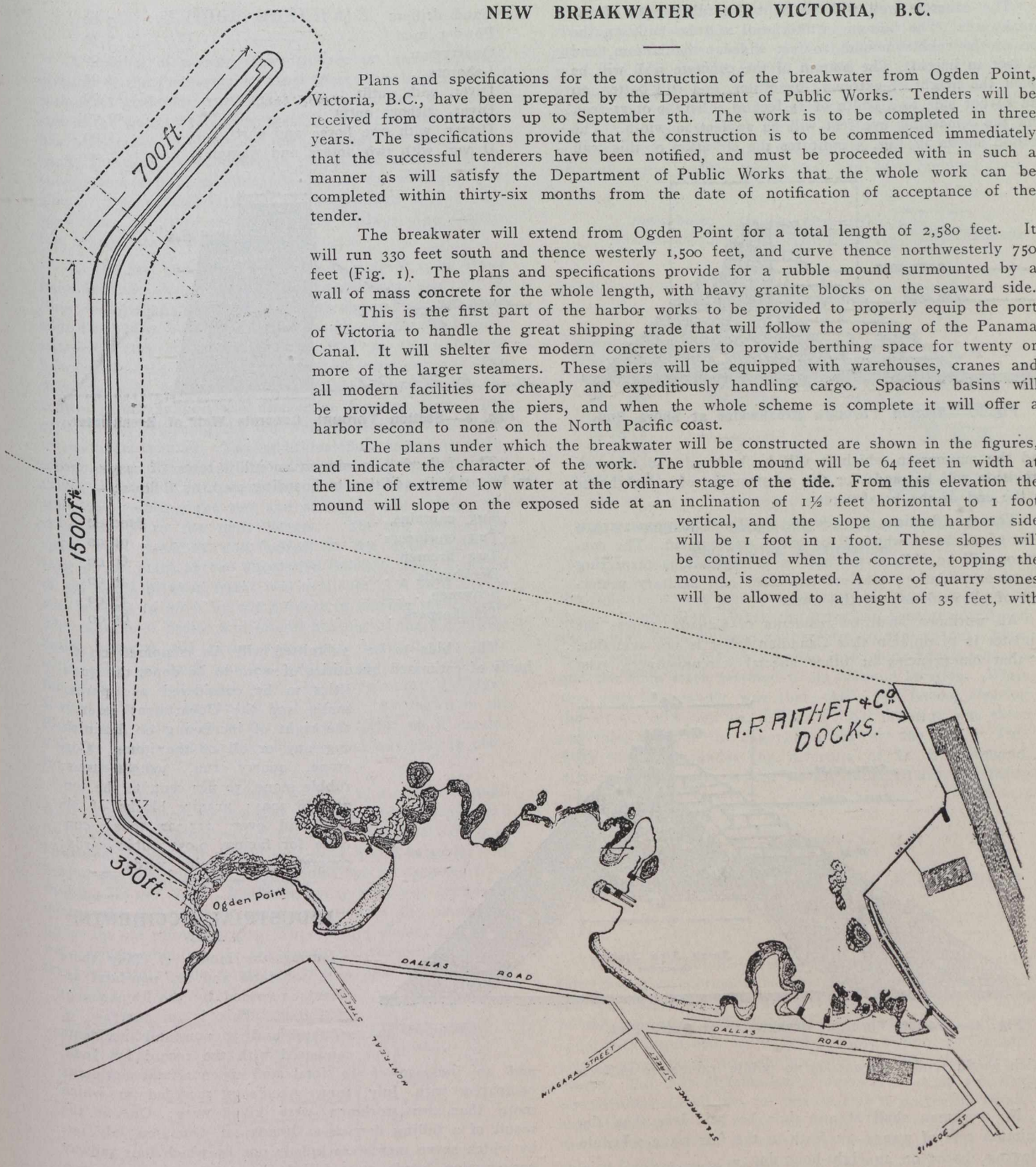

Fig. 1.—Location of New Breakwater at Victoria, B.C.

a width of 62 feet at the top, and with a slope of 1 in 1 to the bottom. The remainder of the stone in the mound, except the large blocks shown in Figs, 2 and 4, on the exposed side, will be built with stone blocks of approved quality at least half weighing not less than a ton each.

The large blocks on the exposed side, from a depth of 20 feet below water level, and averaging 18 feet in thickness, will be built of granite blocks weighing not less than six tons each, and 50 per cent. of the facing stones of this part shall weigh not less than eight tons each. These stones are to be carefully quarried, cut in rectangular blocks, laid so as to bond well, the joints not to be wider than eight inches in any part. All of the stone used will be durable rock of approved quality, to weigh not less than 170 pounds to the cubic foot, the least dimension of any stones to be not less than a quarter of the largest dimension. The large blocks on the exposed face will be all of granite.

The concrete wall will be built the full length of the breakwater. The bottom of this wall will be built on the top of the rubble mound, 20 feet wide at the bottom, and 26 feet in height. The bottom of the concrete wall will be about the height of extreme low water, and will batter on the harbor side to a width of 15 feet at a height of 21 feet, and the remaining five feet will be 10 feet in width. The section shown in Fig. 3 indicates the elevation of this wall

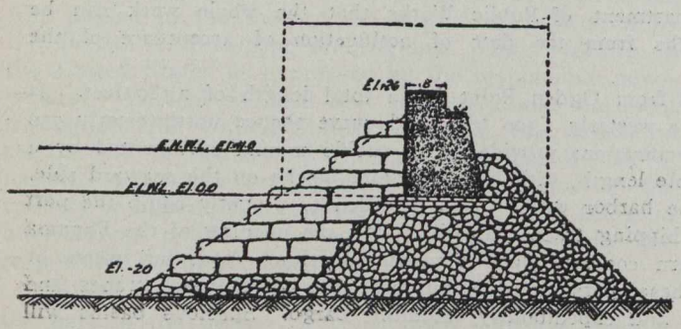

Fig. 2.—Section Through Breakwater at Shore End.

and the manner in which it will be battered and stepped. Provision will be made for the construction of a lighthouse at the end of the breakwater.

The specifications provide for the fair and proper treatment of workmen who will be given employment. The contractor will be obliged to conform to regulations respecting the accommodation, medical treatment and sanitary protection of all workmen on the work.

All workmen shall be residents of Canada, unless the Minister is of opinion that Canadian labor is not available, or that emergencies or other special circumstances exist

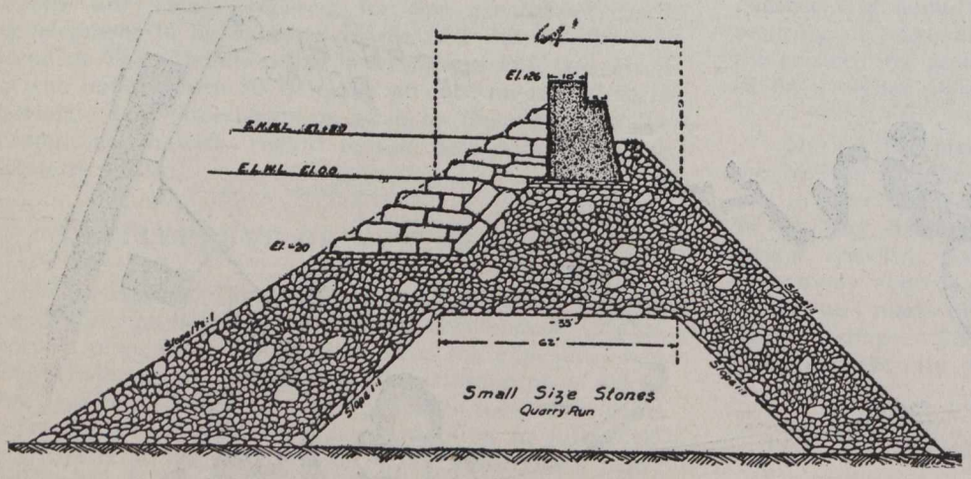

Fig. 4.—Section Through Breakwater at Outer End.

which would render it contrary to public interest to enforce this.

No workman shall at any time be paid less than the minimum rate of wages set forth in the fair wage schedule following, based on an eight-hour day:—

Foreman carpenters	$ 4 75
Foremen mixing concrete	4 00
Foremen laying concrete	4 00
Foremen on stone crushers	4 00
Carpenters	4 25
Blacksmiths	4 00
Blacksmiths' helpers	3 25
Steam derrick engineers	4 00
Steam derrick firemen	3 00
Steam drillers	3 50
Hand drillers	3 00
Powder men	3 50
Quarrymen	3 00
Laborers	3 00
Diver, with outfit	15 00
Diver, without outfit	10 00
Driver, with one horse and cart	5 00
Driver, with two horses and wagon	7 00

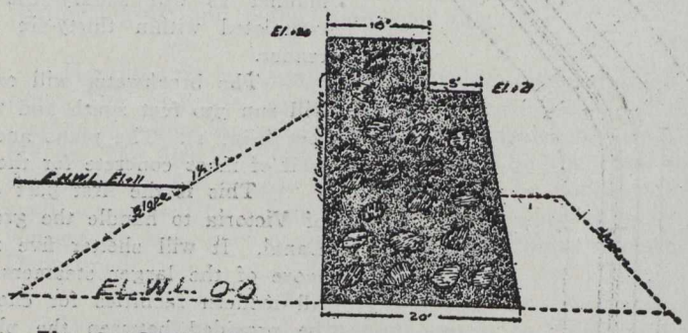

Fig. 3.—Section Through Concrete Wall of Breakwater.

The following minimum monthly rates of wages are to be paid, in addition to boarding men, as follows:—

Tug captains	$100 00
Tug engineers	90 00
Tug firemen	60 00
Deckhands	45 00
Scowmen	45 00
Timekeepers	65 00

The bids to be submitted will be compared on the basis of estimated quantities of work to be done, the quantities to be considered as approximate, and the Department reserves the right of increasing or diminishing any or all of the items. Core stone, quarry run, 306,381 tons; rubble stone, 50 per cent. to the ton, 719,838 tons; granite blocks of six tons and over, 113,322 tons; concrete for facing, 9,031 cubic yards; concrete, 39,832 cubic yards.

INDUSTRIAL ACCIDENTS.

During the month of May there were 108 fatal and 272 non-fatal accidents recorded by the Department of Labor. This is an increase of 46 fatal and 38 non-fatal accidents compared with the record for June, and an increase of 10 fatal and 73 non-fatal accidents compared with July, 1911. Accidents recorded in which more than two workmen were killed were: One as the result of a falling derrick at Kenogami, Que., on July 1st, by which seven men were killed; one by which four railway construction hands were killed by a premature explosion of dynamite on July 23rd, near Maberly, Ont.; one at Kenogami on July 25th by which four men were killed. Two workmen were electrocuted as the result of a falling pile-driver coming in contact with live wires at Meaford, Ont., on July 8th.

The municipal council of Toronto has recently awarded a contract for the manufacture and installation of a number of target light reflectors for the night illumination of various clocks about the city that are under the care of the council. These appliances are to cost $98 each.

BRIDGE RENEWALS.

A number of wooden Howe trusses on the Louisville division of the Pennsylvania Lines West have been replaced with steel girder or truss spans during the last few years, and in the work of replacing these bridges considerable care has been taken to eliminate the necessity for heavy false work, and also to economize in the use of work trains by substituting a light maintenance derrick car whenever possible. Two examples typical of the methods used in this work were described recently in the Railway Age Gazette and are illustrated herewith.

In the first case, shown in Fig. 1, a 146-ft. 5-in. Howe truss and three spans of trestle approach were replaced by three deck girder spans, one 40 ft. long and two 70 ft. long. A spur track was built immediately south of the old bridge, and from this track all material used in the work was handled by the derrick car under its own power. The masonry was first completed and the iron bent for the central girder support was erected on the new pier. The 40-ft. girder replacing the old trestle approach was placed in the usual manner. Two additional floor beams were inserted in each panel of the old truss and the truss was raised about 20 in., the elevation of the rail being kept constant by removing the ties and stringers and spiking the rails directly to the floor beams. The two main-girder spans were assembled and floored on the spur track and were put in place on two successive Sundays when a period of 5½ hours between trains was available. A yard engine was brought 10 miles for the purpose of moving the girders. The rails, floor beams and lateral bracing of the old bridge being removed, the girder spans were lowered into place with jacks, the track was replaced and the load carried on the girders. False work was then driven under the Howe truss and it was dismantled and loaded. As shown in the illustration, this false work was very light, as it carried only the dead weight of the old truss and was only in place for a short time.

In the second case, shown in Fig. 2, a 160-ft. through truss was replaced by two half through girder spans, each 80 ft. long. The delivery of the iron was contracted for in December, making it certain that work would be under way during the winter season when trouble can be expected from running ice and drift. All the masonry work was completed during the early fall except the portion of the abutments under the old through truss. Three heavy cluster pile bents were driven adjoining the abutments and the centre pier on the down stream side, being anchored to bed rock and built

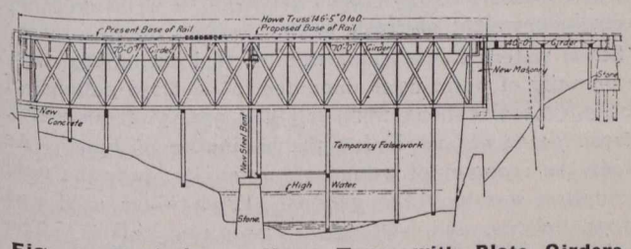

Fig. 1.—Replacing a Howe Truss with Plate Girders.

strong enough to carry the girders under traffic. A light trestle was erected between these cluster bents 18 feet from the main track centre to centre, and a spur with a capacity of three cars was built north of the bridge, the fill being widened for the purpose. When the girders were received the four cars were set on this spur and the girders unloaded and placed with cribbing and jacks on the new masonry and the cluster bents. The division derrick car worked on this track under its own power, placing the floor beams and stringers and removing the light trestle as it receded. The riveting and flooring of the girders were then completed and the fill was widened south of the bridge so that the main track could be carried around the old bridge over the new girders. This track was used at a speed of 10 miles an hour during the dismantling of the old truss. As the derrick car had the freedom of the old main line for the dismantling work there was no necessity for the use of travelers or work trains. The trestle that had been removed from

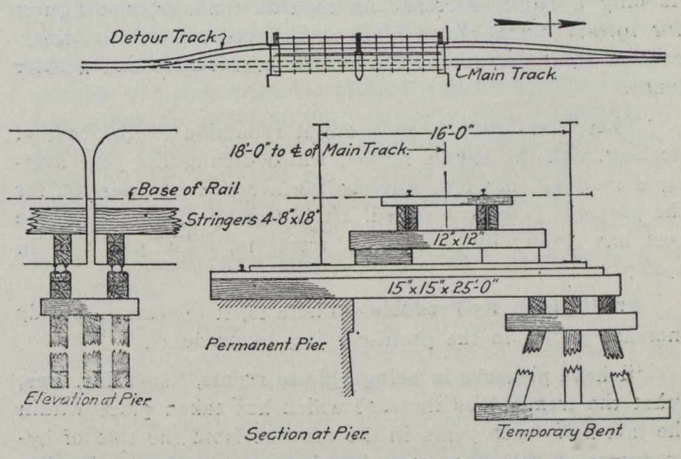

Fig. 2.—Method of Supporting Temporary Track at One Side During Construction.

the run-around was driven under the old truss to support it during dismantling. When the truss had been removed and the bridge seats finished to conform to the masonry plan, the girders were moved sidewise into place between trains and the main track restored to its original location. While this work was under way there were two floods, clearing the stream of heavy ice, and on neither occasion was there any false work in the channel to obstruct the flow. This work was done under the direction of D. B. Johnston, division engineer to, whom we are indebted for this information.

PANAMA CANAL BILL MAY HELP CANADIAN RAILWAY.

Without intending it, the Panama Canal bill in its present form may give enormous advantage to the Canadian Pacific Railway, thinks the Wall Street Journal. Ownership of ships by the railroads of the United States trading through the canal is extinguished, while the Interstate Commerce Commission is given power to regulate ships trading elsewhere so owned. But it is diplomatically impossible, on all construction of international law, for this country to decree the ownership of foreign vessels using the canal. This necessarily gives the Canadian Pacific an enormous advantage, in the ownership of its fleet, over the Southern Pacific or the New Haven, to say nothing of its competitors in the North-West with no ships at all.

This advantage would be emphasized by the possibility of retaliation by Canada in the matter of its own ships canals, which would not be subject to the question of discrimination in favor of our own coastwise trade through the Panama Canal. The American tonnage through the Canadian canals is 18,250,000, as against 1,118,000 for Canadian vessels. A preference to the latter would be of far-reaching consequence, and would, of course, help all the Canadian railways.

AN INTERESTING REPORT ON DESTRUCTION OF REFUSE.

Mr. James Bee, superintendent of the Street Cleaning Department of Blackpool, England, in his annual report states that the quantity of refuse dealt with at the destructor last year amounted to 18,372 loads, the weight of which was just over 18,943 tons. This quantity, though considerably below last year with regard to the number of loads removed, is only a slight decrease as regards tonnage, the figures for 1910-11 being 18,734 loans and 19,000 tons. The difference is accounted for by the carts taking larger and heavier loans.

There has again been a slight reduction in the cost of dealing with the town's refuse, which during the year averaged 1s. 0¾d. per ton, whereas the average cost per ton for the previous year was 1s. 1d. It is worthy of note that the cost has gradually decreased from 1s. 6½d. per ton in 1906-7.

Profits from By-Products.—There is, it appears, a steady increase shown in the profit-earning by-products.

"I have pleasure in being able to report," says Mr. Bee, "that the tremendous increase which has taken place within the last half-dozen years in the revenue from the sale of by-products at the destructor has been maintained. During the year the unprecedented sum of £1,660 was derived from this source, an increase of £55 on the income obtained from last year's sales. To show the wonderful possibilities which lie in what is apparently the waste material of the town, it is only necessary for me to point out that during the year 1904-5 we were deriving what was then considered the respectable sum of £248. We have thus increased our revenue in eight years by £1,412."

A table of statistics shows how the money is obtained. Compared with 1910-11, there are considerable decreases in the sale of ashes and clinkers and mortar, but the yield from fish manure has risen from £558 to £815, which brings about the total increase. During the year 2,327 loads of ashes and clinkers were disposed of, a decrease of 782 loads, which represents a loss of revenue of £102. The quantity of mortar manufactured was 1,490 tons, or 570 tons less than last year, which created a record by bringing a revenue of £470. This year the amount was £330.

Dust Collection.—The work of removing the town's refuse has again been carried out in a satisfactory manner, a daily collection having been maintained in connection with the hotels, hydros, restaurants, and the larger boarding-houses; while from the ordinary company-houses the refuse has been removed from two to three times weekly. All other premises have had attention weekly.

During the year 202 large and 114 medium galvanized iron dustbins have been sold at practically cost price, to replace the less sanitary wooden receptacles.

The collection of waste-paper by means of a duplicate set of bags still continues to prove satisfactory. The experiment, which was tried at the beginning of the year, of allowing waste-paper to be collected by private enterprise, proved so inconvenient to tradesmen that it had to be speedily discontinued, and the work again taken over by the corporation.

The cost of refuse removal has been £5,360, divided into: Labor £2,017, carting £1,682, and hire of horses £1,661. The amount required for this work last year was £5,286, divided into: Labor £1,981, carting £1,621, and hire of horses £1,684. The cost of removal per ton is very little different from last year, labor having cost 2s. 0½d. per ton, carting 3s. 5¼d. per ton, making a total of 5s. 5¾d., an increase on last year of ¾d., accounted for on carting.

Street Cleansing.—The system of collecting street sweepings by means of orderly trucks has been so successful that six additional trucks have been obtained. On the Promenade and in the main thoroughfares men are continually at work. During the past year, for instance, Bank Hey Street was swept no fewer than 4,181 times. All the principal streets are swept from ten to twelve times daily. The less important thoroughfares receive attention daily, and the back streets weekly.

The quantity of sweepings removed during the year shows a large increase, 4,969 loads having been removed by the carts, and 38,237 bins by the orderly trucks, making a total of 8,155 ordinary cart loads, this number being an increase of 485 loads on last year. The corporation carts engaged on this work were employed for 10,306 hours, and were supplemented on 2,447 hours by hired carts, making a total of 12,753 hours. Last year the total was 11,814 hours. The streets swept within the borough during the year amounted to approximately 100 miles.

The expenditure in wages for carrying out the work of street sweeping for the year has been £6,777 for labor, and £713 for team labor and horse hire, a total of £7,490. This is an increase of £305 on the previous year, when £7,185 was expended. This does not include washing streets. The cost per mile has been £74 18s.

During the twelve months washing operations were carried out by the carts on 72 days. The water used amounted to 640,500 gallons, of which 15,050 were fresh water, and the remainder salt water.

In four days in January 1,209 loads of snow were taken away, at a cost of £108. The cost per load works out at 1s. 10d., or 1s. 2d. for labor and 8d. for carting.

It was necessary to grit or sand the streets on 184 days, compared with 211 the previous year.

Street Watering.—Mr. Bee adds: "During the past summer the utility of the new salt water main extensions was very early demonstrated, for during the prolonged drought, when we were prohibited from using fresh water, a plentiful supply of salt water was available, and this enabled us to water the streets without any restriction whatever. Moreover, this work can be done more efficiently and economically by using salt water, for after a road has been watered with it consecutively for three or four days it is practically dustless, even to the fastest motor car. Its deodorizing properties are also a factor in support of its use, not only for street watering, but for flushing gullies and sewers. The salt water mains have now been extended so as to make us entirely independent of fresh water."

Street watering operations were carried out on 162 days. The quantity of water used amounted to 4,898,250 gallons, of which 3,975,300 gallons were salt and 922,950 fresh water. No fresh water was used after the beginning of June. As showing the economy of using salt water, last year the total consumption was 5,056,850 gallons. Fresh water used was 2,129,750 gallons, and salt water 2,927,100 gallons. The quantity of water used last year was the lowest on record. The cost of street watering was £714, or £7 per mile.

SHAWINIGAN POWER COMPANY.

Shareholders of the Shawinigan Water and Power Company will be asked at a meeting called for September 3rd to authorize the issue of $5,000,000 additional capital. The authorized capital stock of the company is at the present time $20,000,0000, of which $10,000,000 remains unissued.

ELECTROLYTIC ACTION ON UNREINFORCED CONCRETE.

In a brief paper before the International Association for Testing Materials, Mr. Cyril de Wyrall, Chief Inspector, Interborough, Rapid Transit Co., New York City, cites observations indicating the destruction of plain concrete by electric currents. We abstract a portion of his remarks as follows:

Four years ago an inspection was made of a concrete wall, which was erected in 1902. This wall, which carried no load, is below tide level, is 3 ft. thick, and is made of 1:2:4 mixture of cement, sand and trap rock. It was placed with care and under competent superintendence. The examination showed a disintegration to such an extent that the surface was practically mush. A year later another examination was made, and large sections, from 4 to 6 ins. thick, which crumbled in the hands, could be pulled off the face Last year still further deterioration was found to be in progress, and a chisel could be driven 12 ins. into the wall by hand alone. A voltmeter test showed that current under 11 volts pressure was passing through this structure. It was believed at the time of the second examination that the "failure" was due to the action of salt water alone, and no test was made for stray electrical currents until lately.

This is not an isolated case. There is an exact duplicate in almost every particular, except that the latter structure was erected a year later and different brands of cement were used. In the summer of 1911 the writer made an inspection of some concrete tunnels and bridges erected by three different railroads entering New York. This work has been only recently finished. Each of the railroads had its own cement laboratory, and the different brands or cement used were rigidly tested. The structures are all above tide level, and wet only in spots. Where the concrete is wet, from one to five volts was found, and the concrete is deteriorating, though not as much as in the former instances. Where the concrete is dry no voltage was found and the concrete is in excellent shape; this occurs in the same tunnel. the concrete apparently being the same mixture and placed at the same time. It seems to make no difference whether the concrete was placed in cold or warm weather, deterioration goes on just the same, the only difference being between the wet and dry places.

It is a known fact, although wet concrete is an excellent conductor, dry concrete is practically a non-conductor. The combination of electric current and water seems to act as a disintegrating agent on the cement, destroying its cohesion and reducing it to a paste, which when dried can be pulverized with the fingers. This condition demands immediate remedial measures, or serious trouble will undoubtedly ensue.

It is only the effects, which careful and continuous examinations have shown, which are brought to your attention. One efficient means of preventing the damage may be mentioned, however: waterproofing thoroughly all parts of a concrete structure that is surrounded by earth. Such protection acts in two ways; it keeps the structure dry and it insulates against electric currents.

ABITIBI PULP LIMITS SOLD

Greater activity is evidenced in the development of Northern Ontario. Settlers are entering the country more rapidly, but are not likely to patronize that region in large numbers until the advent of ready made farms. Messrs. Shirley Ogilvie and F. H. Anson of Montreal, are the successful tenderers for the Abitibi pulp limit offered by the Ontario Government. The amount of the bonus to be paid to the government is $5,000 per year, distributed over a period of twenty-one years, making $105,000 from this source alone. This represents only the right to cut pulpwood and timber on the limit, which comprises 1,560 square miles, and entitles the successful tenderer to obtain a lease, upon the usual terms, of Iroquois and Couchiching Falls for power purposes.

An additional undertaking, not required by the government, which Messrs, Ogilvie and Anson have inserted in their offer, is that during and after 1913 they will advance for the purpose of being expended or shall expend $50,000 in preparing buildings and land for settlers in the neighborhood of Iroquois Falls. None of the land on the limit goes with the lease, so the conditions under which this money is to be expended will be decided by the Minister of Lands, Forests and Mines, although a lien will be retained on all property sold until the purchasers repay the amount on each farm in easy instalments.

The tenderers also agree to buy wood and agricultural products from the settlers and covenant to promote as far as in their power the development and settlement of the district.

A joint stock company with a capital of $1,500,000 is to be organized to carry out the enterprise.

An integral part of the scheme is the construction of a pulp mill costing, with equipment and machinery, not less than $500,000, with a daily output of one hundred tons of pulp and the employement of two hundred and fifty-nine hands on an average for ten months in the year. This investment is distributed—$100,000 during the first year; $200,000 during the second year; and the balance during the third year. Cutting may commence on the limit so soon as $100,000 is expended on the mill.

The successful tenderer is also under agreement to erect a paper mill on the order of the Lieutenant-Governor in Council, which shall have a capacity of one hundred tons of paper per day and shall turn out not less than seventy-five tons of paper per day.

Another likely development is the starting in Northern Ontario of a system of forest industries, employing trained men and operated upon lines that will mark a departure from the wasteful lumbering methods of the past. Negotiations are proceeding by which, it is expected, a large area in the north will be secured by private interests and devoted to the making of wood products that will utilize every inch of the trees from roots to top. With it will be carried on reforesting and the scientific culture of existing timber.

Mr. F. L. Barledt, a British capitalist who controls similar industries in Germany and Russia and is interested largely in a number of enterprises in England is behind the project. Mr. Barledt is in Toronto awaiting the outcome of the negotiations. Although a British citizen he is German born.

NEW PUMPS AT WELLAND, ONTARIO.

The pumps at the new pumping station of Welland, Ontario, have recently been put into service. The pumps were constructed by Messrs. Frank Pearn and Company, Limited, Manchester, England, and supplied by the Canadian Boving Company, Bay Street, Toronto. The water wheel is designed for the following:—Net head, 7 feet; normal output, 200 brake horse-power; maximum output, 250 brake horse-power; normal speed, 58 revolutions per minute.

THE CLEANING OF WATER MAINS.*

By F. W. W. Doane, City Engineer, Halifax.

The injunction from the secretary, limiting the extent of these discussions to one thousand words, makes it very difficult to deal fully with this important subject.

On the inside of all water supply pipe which has been in use for any length of time, there will be found an incrustation of oxide of iron more or less heavy. This coating presents a very rough surface compared with the original finish. It consists of tubercles or blisters shaped like a rivet head and varying in size, between which is an accumulation of sediment or ferruginous slime which greatly reduces the internal diameter and consequently the discharging power of the pipe. In some cases the discharging and carrying capacity of the pipe is reduced more than 50 per cent. and the thickness of the incrustation varies from ¼ inch to 1¼ inches.

This incrustation has been removed annually from the pipes supplying the city of Halifax ever since 1880, by a mechanical scraper forced through the main by the pressure of water.

The scraper used there consists of two distinct portions, the front portion carrying the steel scrapers and the rear propelling the machine. There is a stout centre rod of wrought iron in two pieces, coupled together in such a manner as to allow a little play, so that the machine may pass round and bend or angle in the pipe line. There are eight arms of spring steel varying in width and thickness according to the diameter of the pipe, arranged in two sets of four each, the set behind breaking joint with that in front, so as to effectively scrape the entire inner circumference of the pipe. Each spring has a cutting edge tapered towards the centre of the pipe with the double object of cutting or splitting longitudinally any heavy incrustation of iron rust, and also of preventing the barbed knife from catching in any valve or defective or open joint in the pipes which would also cause a stoppage. A ferrule or similar obstruction striking the knife will cause the scraper to turn partially round and thus pass the obstruction without getting blocked, or the springs will yield sufficiently to enable it to pass.

The pistons or discs do all the work in propelling the machine forward. They are made double in order to insure steadiness, and they do not do any cutting work whatever. The discs are of iron, somewhat smaller in diameter than the the bore of the pipe, so that water may pass them to wash out the accumulated scrapings cut away. The iron discs are backed with leather discs intersected by radial cuts and stiffened at the back by lead plates, their construction giving them sufficient stiffness to withstand the pressure of the water one way and yet allowing them to yield backwards to pass any obstruction not removed by the cutters. In large sizes, small springs are attached to the back of the iron discs for the purpose of maintaining the machine exactly in the centre of the pipe. This is necessary with the large scrapers on account of their great weight. They also preserve the leather discs from being worn out too rapidly. Rings are screwed on each end of the centre rod for convenience of handling.

Twenty-one years of experience and study has convinced the speaker that the tuberculation begins in consequence of the iron in solution in the water being deposited by coming in contact with the metallic iron through minute defects in the coating. The water so acts on the surface of the metal that at times it is quite an easy matter to cut the iron with a knife after the tubercle is removed. The action of chemical salts and substances which form marsh land, and the salt water, corrode the iron rapidly from the outside and soften it in the same manner as the corrosive action referred to above, on the interior.

To prepare for cleaning, a section of pipe must be removed at each end of the main to be cleaned. The scraper is inserted, the section of pipe replaced, and the water turned on. The scraper starts off with a rumbling noise, by which it can be easily followed by men running along the pipe line. The rate of speed varies from ¼ of a mile an hour on the flat ground under a small head of water or going up a hill, to six miles an hour or faster, going down a hill. Where there are hydrants or blow-offs, they are left open and the approach of the scraper may be detected first by a current of air, followed by a rush of water which has accumulated in front of the machine. The water turns to a dirty brown color and as the scraper passes, the water becomes black. After the passage of the scraper, if the water is allowed to run from the hydrant, it gradually becomes clearer. It is out custom, however, to close the hydrants at once after the scraper passes, so that the pressure behind it may not be reduced.

In the city of Halifax the greatest length of pipe cleaned in one day is a supply main in two sizes, 15-in. and 20-in., and seven miles in length. It has been the custom to clean this main three times a year, while the other supply main is cleaned once a year only, and distribution mains when required. The first cost of cleaning the first twelve miles of mains over 30 years ago, averaged 3½ cents a foot for everything, including manholes, the lowest cost being 1⅔ cents and the highest 7 1/5 cents. The average cost, not including manholes was 2 8/10 cents.

Twenty-nine thousand five hundred feet of 15-in. main has been cleaned in 95 minutes, and the whole seven miles at a cost of $8.30, or 3/100 of a cent a foot. The lowest head operated under is 11 ft., but cleaning could not be done under such conditions except by an experienced man The heaviest incrustation removed is 1¼ in. from a pipe which had been laid between 30 and 40 years and was uncoated, while a 1-in. pipe has been closed in four years.

The cost for re-cleaning supply mains during 25 years was 1/16 of a cent per foot. On one occasion they were cleaned for 1/20 of a cent. Cleaning distribution mains is a little more expensive and varies from 1/10 of a cent to ½ cent a foot. The cost of cleaning by hand, before the mechanical scraper was used, was 14 2/10 cents per lineal foot.

Some of the immediate results were that the average pressure on 25 hydrants increased from 34.2 lbs. in February of one year, to 54.4 lbs. in February following, or 53 per cent. In another district there was a pressure of 19 lbs. after the cleaning, on hydrants where in the previous year there has been no water at all. In one cleaning an improvement of 400 per cent. was obtained, while at Louisville, Kentucky, they claim an improvement of 654 per cent. in one case.

The cleaning in Halifax has saved the city a large expenditure, the cost averaging about $3.25 a mile, while if it had not been possible to clean with a mechanical scraper, many of the mains would have been renewed long ago at a cost of many thousands of dollars.

Contracts have just been let by the Montreal Transportation Company by which the Canadian canal trade will have the first electrically propelled merchant vessel ever built. The principle of propulsion for this vessel is identical with that of the "Gas Electric" railway car, of which an example was recently seen in Toronto on the line of the Canadian Northern.

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*Paper read before meeting of Union of Canadian Municipalities, Windsor, Ontario, August 28th, 1912.

CANADIAN PACIFIC'S EXPANSION

The increase in the capital of the Canadian Pacific Railway, noted in last week's Monetary Times, and which will shortly be made, again draws attention to a railroad which has loomed large in the international investment eye. The increase will be from $200,000,000 to $260,000,000. There is little doubt as to the need of increased funds by the Canadian Pacific. It has a long programme of construction ahead, the most important part of which, perhaps, is the double tracking of the road to the Pacific Coast. Both passenger and freight traffic is rapidly increasing, and within a few years there will be work and constant use for a double track. Expansion of the company's hotel and steamship services, both of which have proved remunerative and in both of which there is room for expansion, will probably occur.

While it was not intended, the news of the new stock issue became public shortly after the publication of the company's preliminary statement for the year ended June 30th. It shows record earnings and constitutes a fairly good index to trade conditions in Canada to-day. The gross earnings by the railway and its allied steamship lines, with the working expenses, for 1911-12 and the six preceding years are given below:—

	Earnings.	Expenses.
1911-12	$123,319,541	$80,021,298
1910-11	104,167,808	67,467,977
1909-10	94,989,490	61,149,534
1908-09	76,313,320	53,357,748
1907-08	71,384,173	49,591,807
1906-07	72,217,527	40,914,218
1905-06	61,669,758	38,696,445

In six years the operating income of the railway and its properties has doubled, the operating expenses having rather more than doubled. This showing has been made during a period of increased competition, and in face of a tendency to reduce rates, for carrying both passengers and freight.

The company's dividends have been steadily maintained and the shareholder naturally has every confidence in their maintenance. It would be a disaster beyond modern foresight that would cause the passing of the Canadian Pacific Railway dividend. Invariably, too, the company has been able to report a large surplus after the payment of all dividends. Commenting on that fact, the London Statist reminds us that the company could stand a shrinkage in its traffic and gross earnings of something like 25 per cent. before the profit would cease to be sufficient to provide the 10 per cent. dividend. A shrinkage of 25 per cent. in traffic and in earnings is a very large sum, and that to have a margin of this kind indicates the conservative manner in which the company's financial policy is controlled.

There is an idea that a further increase of dividend to a still higher basis than 10 per cent. may take place, but those persons who expect an increase in distribution would do well to remember that it is wiser to pay a dividend which the company can maintain in good and bad years alike, than to distribute a dividend which would have to be seriously cut in a time of depression, or which could not be maintained in a period of increased competition.

The interests representing the Labrador Pulp and Power Company have decided on a large pulp and paper enterprise, involving the increase of the capitalization of the company from three millions to fifteen millions of dollars, stated Mr. Robert H. Reid, of New York, vice-president of the company.

WILL THERE BE A CAR SHORTAGE?

That a car shortage is imminent is the opinion of Mr. J. E. Walsh, transportation manager of the Canadian Manufacturers' Association. "An estimate based on railroad figures of the past four years tends to show that shippers will be confronted with a car shortage of sixty thousand this year on the smallest possible estimate, and as great a deficit as 180,000 cars should the proportion be as high as it was in October, 1909.

Vice-President Bury, of the Canadian Pacific Railway, said that so much has been done in preparation for handling the crop by concentrating rolling stock and motive power, together with the earliness of the season, it is improbable that there will be any blockade.

RAILROAD EARNINGS.

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

	1911.	1912.	Increase or decrease.
C. P. R.	$2,272,000	$2,706,000	+ $434,000
G. T. R.	1,017,982	1,109,682	+ 91,700
C. N. R.	332,500	407,300	+ 74,800
T. & N. O.	35,274	30,905	— 4,369
Halifax Electric	5,641	5,646	+ 5

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

	1911.	1912.	Increase or decrease.
C. P .R.	$2,205,000	$2,677,000	+ $472,000
G. T. R.	1,048,062	1,098,423	+ 50,361
C. N. R.	319,700	401,800	+ 82,100
T. & N. O.	36,830	29,838	— 6,992
Halifax Electric	5,714	6,486	+ 772

The accounts for the Grand Trunk Railway Company for the half-year to the 30th of June, 1912, show the following results:

Gross receipts		£3,834,300
Working expenses		2,793,300
Net receipts		£1,041,000
Deduct debit balance on account of rentals, outside operations and car mileage		33,500
Total net revenue		£1,007,500
Net revenue charges for the half-year, less credits		513,900
Balance		£ 493,600
Deduct Canada Atlantic deficiency for the half-year	£52,800	
Detroit, Grand Haven & Milwaukee deficiency for half-year	50,700	103,500
Surplus		£ 390,100

This surplus of £390,100 added to the balance of £6,800 from December, 1911, makes a total amount of £396,900 available for dividend, which will admit of the payment of the full dividend for the half-year on the four per cent. guaranteed stock, and first and second preference stocks, leaving a balance of about £8,500 to be carried forward.

The accounts of the Grand Trunk Western Company for the year ending 30th of June, 1912, after providing for all fixed charges, including the debit balance of £31,461, brought forward from the previous year, show a deficit of £16,144, which will be carried forward to the current year.

ENGINEERS' LIBRARY

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

BOOK REVIEWS.

Reference Book for Statical Calculations.—By Francis Ruff; published by Constable & Co., London. Cloth; 5 x 8 ins.; 160 illustrations; 136 pages; price $1.25.

This book is the translation of the German volume of the same name. It contains, in shape for rapid use, force diagrams for frame works, tables, instructions for statical calculations for all classes of building and engineering. The different application of statics to engineering design is presented in a comprehensive and clear manner. The use of the book should be conducive to carrying out any desired statical calculations with ease and rapidity. A compendium of tables at the end of the work includes tables for timber, weights of railway bridges and street bridges, weights of various materials, specific weights and loads used in building, etc. These tables will certainly spare the owner of the book a great deal of labor. The volume is intended as a reference book purely. It should be in the hands of every engineer and architect, for as a ready reference book on statics, it is the best we have seen.

Reinforced Concrete Construction.—By Geo. A. Hool; published by the McGraw-Hill Book Co., New York. Cloth; size 6¼ x 9½; first edition; 250 pages: price $2.50.

This is another volume of the Engineering Education Series, prepared in the extension division of the University of Wisconsin, for the use of their students in the correspondence courses. Vol. I. of Reinforced Concrete Construction deals with the fundamental principles of concrete construction and design and includes numerous tables and diagrams to facilitate the calculation and design of reinforced concrete structures. The book presupposes a knowledge of the elements of structures and is written to meet the needs of those who desire to take up the study of the subject by correspondence. There appears to be no reason, however, why it should not be employed for other purposes. The complete text for the course in reinforced concrete construction will be in three volumes, of which this is the first. The ground covered by this volume is the theory of the detailed design of retaining walls and building, but omits, however, the flat slab type of floor construction, which will be taken up in Vol. II. The treatise is most clearly written and the discussions are concise, yet full enough to be easily followed.

Concrete Workers Reference Books.—Published by the Norman W. Henley Publishing Co., 132 Nassau Street, New York. Paper; size 5 x 7½; by A. A. Houghton; price 50 cents.

The two new volumes of the series of Concrete Workers Reference Books, by Mr. A. A. Houghton, have just come to hand. No. 10 of the series, entitled "Moulding Concrete Flower Pots, Boxes, Jardinieres, etc.," presents a complete explanation of various successful methods for constructing the above. No. 11 is entitled "Moulding Concrete Fountains and Lawn Ornaments." These little volumes contain a great deal of valuable information for the practical constructor.

Diary of a Roundhouse Foreman.—By Mr. T. S. Reilly; published by the Norman W. Henley Publishing Co., 132 Nassau Street, New York. Cloth; 5 x 7; 158 pages; price $1.00.

This little volume is a compilation of a series of articles by the author which were published in the "Railway and Engineering Review." It contains many suggestions in connection with the duties of a roundhouse foreman, and much of the material for the book was obtained while the author occupied the position of machinist, roundhouse foreman and superintendent of motive power. It is a most interesting little volume and will be read by the railroad man with a good deal of pleasure.

Metropolitan Water Board: Eighth research report on the softening, purification and sterilization of water supplies. By Dr. A. C. Houston, director of water examination.

In his seventh report Dr. Houston mentioned that he had found that one part of quicklime added to 5,000 parts of raw river water was capable of killing B. coli in from five to twenty-four hours. The Water Board are in the position of being unable to purify all the water required in London by the method they prefer, viz., storage. Dr .Houston has set himself the task of finding out if his discovery with regard to the effect of quicklime will help the Board out of the difficulty, and tells his story in this his eighth report. To the treatment he gives the name of "Excess Lime Method," and briefly he finds that when one part of quicklime (about 75 per cent. CaO) is added to 5,000 parts of raw Thames water, about .007 per cent. free CaO is left in the mixture, and this excess is sufficient to kill B. coli in from five to twenty-four hours. To neutralize the excess, not less than 25 per cent. of store water must be subsequently added. The resulting fluid is water which has been purified ("placed beyond the pale of epidemiological criticism"), clarified and softened. On the question of softening Dr. Houston is led into a most interesting discussion as to the relative advantages of hard and soft waters. On health grounds he believes that there is absolutely no reason for objecting to hard water. On grounds of economy there are reasons, though they are, after all, not serious. The furring of boilers and pipes and consequent loss of heat is perhaps the most important, but the wastage of soap is largely a theoretical objection. For these reasons he does not believe that in the case of London water, at any rate, it is worth while incurring expense in providing plant, etc., and purchasing quicklime for softening purposes only. If in addition you can purify the water without the necessity of storing more than a fourth of all that is required, it is worth while. Quite satisfied with the method, Dr. Houston recommends it to the Water Board as a way out of their diffculties. Apart from mentioning that the quicklime costs a penny per pound, and that the London County Council, who use 25,000 tons per annum at the sewage outfalls, got it for 13.75 shillings a ton in 1910, the financial side of the question is not entered into much. The amounts required for tanks and so on must be estimated by engineers, financiers, etc. The report itself, however, is, as is usually the case with Dr. Houston's reports, intensely practical and interesting, and the experiments are clearly

described. The work marks a tremendous advance in our knowledge of water purification.

Pumping and Water Power.—By F. A. Bradley; published by E. F. Spon, 123 Liberty Street, New York; size 6 x 9; 120 pages; price $1.50.

The book was written by a consulting engineer, and although many works have been written embracing the subject of hydraulic work, pumping appliances, and the application of hydraulic power, they usually treat of some especial feature or branch of the subject, or of mechanical details of construction, or the book is too costly to be within the reach of mechanics, students, and others to whom a general explanation of the laws of hydraulics and their practical application would be serviceable. The present treatise will meet a necessity in this respect.

The work includes chapters on important laws of hydraulics, atmospheric pressure, pumping work, suction pipes, units of work, steam pumping, centrifugal pumps, hydraulic power machinery, hydraulic rams, waterwheels, turbines, pelton wheels, water pressure engines, and well boring.

And ten tables which includes areas of circles, square cubes, square roots and cube roots, loss of pressure by friction in pipes, weight of water at different temperatures, weight and quantity of water in one foot of pipe, average pressure of expanded steam, volume of steam at various pressures, theoretical velocity of water, downward flow turbines and pressure of water.

The book is well illustrated and a study of its contents should assist those engaged in erecting or using hydraulic machinery to lay out their work with confidence.

Webster's New International Dictionary.—Published by G. and C. Merriam & Company, Springfield, Mass. Leather; 9 x 12 ins.; 2,620 pages; profusely illustrated; price $12.

This new dictionary of the English language, which is based on the International Dictionary, of 1890 and 1900, is now completely revised in all departments. The new edition includes a dictionary of geography and biography. The first edition contained 70,000 words; this edition contains 400,000 defined words and phrases. Among the interesting features are the divided page, an up-to-date gazetteer and biographical dictionary, and 6,000 illustrations, many of them in color. This dictionary should be in the hands of every professional man.

PUBLICATIONS RECEIVED.

Proceedings of the Royal Military College Club of Canada. Editor, Lieut.-Col. Ernest F. Wurtele.

Commercial Creosotes. With special reference to wood from decay. By Carlisle P. Winslow. Being Circular 206 of the Forest Service, U.S. Department of Agriculture.

The Effects of Cold Weather upon Train Resistance and Tonnage Rating. By E. C. Schmidt and F. W. Marquis. Bulletin No. 59, University of Illinois, Engineering Experiment Station, Urbana, Ill. Price 20 cents.

American Road Builders' Association. Proceedings of the eighth annual convention, held at Rochester, N.Y., Nov. 14-17, 1911. Published by the association, 150 Nassau Street, New York. Price $1.00.

Forest Products of Canada, 1911—Pulpwood. Compiled by H. R. Macmillan, B.S.A. Bulletin No. 30, Forestry Branch, Department of the Interior.

Report on Mining Operations in the Province of Quebec During the Year 1911. The Mines Branch, Department of Colonization, Mines and Fisheries, Province of Quebec.

Seventh Report of the Bureau of Archives for the Province of Ontario. By Alex. Fraser, Provincial Archivist, Toronto, Ont.

Mica; Its Occurrance, Exploitation and Uses. Second edition, by Hugh S. de Schmidt. Mines Branch, Department of Mines, Ottawa.

Diamond Drilling at Point Mamainse, Province of Ontario. By Alfred C. Lane, Ph.D. Bulletin No. 6, Mines Branch, Department of Mines, Ottawa.

The Metropolitan Water Board. Eighth report of research work, by Dr. A. C. Houston, on the softening, purification and sterilization of water supply. Metropolitan Water Board, London, E.C.

Queen Victoria Niagara Falls Park. Twenty-sixth annual report of the commissioners. Copies may be secured from the superintendent, J. H. Jackson, Niagara Falls, Ont.

The Fifth Census of Canada, 1911. Vol. I., containing areas and population by provinces, districts and sub-districts. Department of Trade and Commerce, Ottawa.

Tenth Report of the Geographic Board of Canada for year ending June 30th, 1911. Being supplement to the annual report of the Department of Marine and Fisheries, Ottawa.

Third Annual Report, Commission of Conservation of Canada. The report of the third annual meeting held at Ottawa, January 16th, 1912. James White, secretary, Ottawa.

The Canada Year Book, 1911. Second series. Ottawa, Ont.

Ottawa Improvement Commission. The report and correspondence of the Ottawa Improvement Commission relating to the improvement and beautifying of Ottawa. Ottawa, Ont.

Telephone System. The Ontario Telephone Act. Municipal Ownership of Rural Telephone System, by Francis Dagger, Toronto, Ont.

Annual Report of the Minister of Mines, British Columbia, for the year ending 31st December, 1911. Being an account of mining operations for gold, coal, etc., in the province of British Columbia.

Preliminary Report on the Clay and Shale Deposits of the Western Province. By Heinrich Ries and Joseph Keele, being memoir No. 24 E Geological Survey Branch, Department of Mines, Ottawa.

Chain Belt. Paper, 6 x 9 ins., 8 pages. Chain Belt Co., Milwaukee, Wis. This is the August number of "Chain Belt," and it contains a descriptive article of the method adopted for roundhouse construction on the Lake Shore & Michigan Southern R.R. at Chicago, by means of the shooting system and movable steel towers 72 feet high.

CATALOGUES RECEIVED.

Wire Rope and Fittings. The B. Greening Wire Company, Limited, Hamilton, Ont., forward catalogue illustrating their wire rope and rope fittings.

Lead Wool. How to Use It. Pamphlet issued by the United Lead Company, 111 Broadway, New York, describing the use of lead wool.

Green's Fuel Economizer. Catalogue No. 142, forwarded by the Green Fuel Economizer Company, Matteawan, N.Y., describing different installations of the economizer.

Stokers. The American Stoker Company, 11 Broadway, New York, forward Bulletin B-I entitled "The Class 'E' Stoker," describing their new underfeed type of stoker.

Patent Steel Pipes. Stewart's and Lloyd's, Limited, Glasgow, forward catalogue describing the Stewart patent steel pipes.

Herringbone Gears. The Earle Gear and Machinery Co., Philadelphia, Pa., forward pamphlet describing their Herringbone gears.

Motor Trucks. The Canada Foundry Co., Limited, forward pamphlet illustrating the Knox-Ajax trucks for commercial use.

Industrial Railways. Catalogue No. 12-1, issued by the C. W. Hunt Company, West New Brighton, N.Y., illustrating Hunt industrial narrow gauge railways for handling raw and finished material.

Hayward Buckets and Digging Machinery. Being pamphlet No. 590, issued by the Hayward Company, 50 Church Street, New York, illustrating the use of their buckets and digging machinery.

Continuous Current Dynamos and Motors. Bruce Peebles and Co., Limited, Edinburgh, forward catalogue illustrating their medium size, self-contained continuous current dynamos and motors.

Gutta Percha India Rubber Covered Wires. The India Rubber Gutta Percha and Telegraph Works Co., Limited, London, E.C., forward price list of Gutta Percha India Rubber silk and cotton covered wires.

Mesta Machine Company forward 5 x 7-inch pamphlet, being a brief description and illustrations of their plant and products. Copies may be secured by addressing the Mesta Machine Company, 1245 Oliver Building, Pittsburg, Pa.

Glover's Cables. Descriptive catalogue and price list of cables for electric lighting, power and traction purposes. Manufactured by W. T. Glover & Co., Limited, Trafford Park, Manchester. Being List No. 4, Mains Section.

Westinghouse commutating pole direct current motors (Type QM) for compressors, blowers, pumps, and similar classes of service are fully illustrated and described in leaflet 2499, issued by the Westinghouse Electric Manufacturing Co.

Rules for the Selection of Machine Tool Motors, is the title of a leaflet (2480) just issued by the Westinghouse Electric and Manufacturing Co. Quite a lot of valuable information is here condensed into a small space relative to the selection of a motor with the proper characteristics for the desired duty.

Faessler's Safety Sectional Expander with Quick-Acting Knockout, is the title of new bulletin No. 28, just published by the J. Faessler Manufacturing Co., Moberly, Mo. This bulletin illustrates and describes a new sectional expander which eliminates side blows on removal of the mandrel, eliminates danger of accident, and effects a marked saving in time.

Circular 1516, attractively bound in an art cover, has been issued by the Westinghouse Electric and Manufacturing Co., on electric locomotives. The locomotives, as built by this company jointly with the Baldwin Locomotive Company, of Philadelphia, are described and illustrated in detail. This publication discusses the field of application of the electric locomotives to both steam and electric railways, and shows numerous applications on roads throughout the country.

Switchboard Meters is the title of an attractive publication with an art cover just issued by the Westinghouse Electric and Manufacturing Co., which very fully describes the complete line of switchboard meters recently brought out by this company. In addition to describing and illustrating these meters, the circular contains reprints of papers by Mr. Paul McGahan on (1) Modern Tendencies in the Design of Switchboard Indicating Meters, and (2) Theory and Performance of Induction Instruments.

The Westinghouse Electric and Manufacturing Co. has just issued a series of descriptive leaflets (Nos. 2465 to 2473) illustrating the new line of switchboard seven and nine-inch indicating meters. In each leaflet is a full-sized facsimile of the meter dial, the purpose being to present a correct idea of the actual appearance of the meter when installed. By placing these leaflets on the wall an accurate idea of the readability of the meter may be gained from any distance and angle.

Descriptive Leaflet No. 2494 issued by the Westinghouse Electric and Mfg. Co., fully illustrates and describes the Westinghouse synchronous booster rotary converter. This machine consists of a standard converter in combination with a revolving armature alternating current generator mounted on the same shaft with and having the same number of poles as the ammeter by means of which the direct current voltage delivered may be varied.

Sewage Distributors. Through the courtesy of Messrs. Laurie and Lamb, 211 Board of Trade, Montreal, we have received a copy of the new 140-page catalogue issued by Messrs. Tuke and Bell, Limited, of London, England, for which firm Messrs. Laurie and Lamb are sole agents for Canada. The catalogue which is bound in stiff covers, illustrates and describes various types of sewage sprinklers, distributors, ejectors, centrifugal pumps, penstocks, sewage screens, and many other pieces of apparatus of general interest to municipal engineers and of specific interest to those who have to do with the construction and maintenance of sewage disposal equipment. We would advise those interested to write Messrs. Laurie and Lamb for a copy of the catalogue.

The following two letters are fair samples of many letters which reach our office almost daily.

Toronto, Ontario,
August 20, 1912.

The Canadian Engineer,
Toronto.

Gentlemen,—I have yours of August 15th re the..... advertisement and subscription. I certainly would not or could not do without your paper, but you will have already received notice from the .....Head Office ordering the paper to be sent to me

Yours very truly,

.....
Consulting, Designing and
Inspecting Engineer.

St. John, N.B.,
August 15th, 1912.

The Canadian Engineer,
Toronto.

Gentlemen,—Kindly send my copies of The Canadian Engineer to me at St. John, N.B., instead of ..... Gloucester Street, as at present. I hate to be without your weekly paper for even one issue.

Yours truly,

.....
Civil Engineer.

CANADIAN FAIRBANKS-MORSE TO BUILD TRACTOR FACTORY.

Messrs. T. Pringle and Son, Ltd., engineers and architects, Montreal and Toronto, have prepared designs for a large modern tractor factory to be erected on the south end of the property of the Canadian Fairbanks-Morse Company, Limited, Bloor Street, Toronto. The building will be 397 feet long by 100 feet wide, and will consist of concrete foundations with structural steel framework and brick walls. Steel sash will be used throughout for all windows. The forge shop will be 122 feet by 49 feet; testing room, 76 feet by 49 feet; erecting shop, 172 feet by 49 feet; structural steel shop, 318 feet by 49 feet, and the tin shop 397 feet by 49 feet. The structural steel shop will be served by two one-ton cranes and the erecting shop by a 12-ton crane. A very complete system of industrial railways will serve all portions of the plant. The paint shop is to occupy the end of the erecting shop, and it is from here that the tractors will be loaded directly into the cars on the siding. The factory will cost about a quarter of a millian dollars and will be, when completed, one of the finest equipped plants in the world for the manufacture of tractors.

INCREASED WORK OF TORONTO'S NEW CIVIC LABORATORIES.

The laboratories of the Medical Health Department of this city were recently moved from very cramped quarters to spacious rooms and the results from the increased facilities is well shown by the following statistics.

In all, 2,385 specimens have been examined, as compared with 1,420 in July, 1911, as follows.—

	July, 1911.	July, 1912.
Diphtheria cultures	861	634
Tuberculosis sputum	46	106
Typhoid blood	49	39
Gonorrhœa	8	7
Water specimens	104	343
Milk for bacteria	152	284
Milk cans for bacteria	...	121
Milk for fat	200	423
Milk for dirt	...	428
	1,420	2,385

PROGRAMME OF THE FIFTH ANNUAL MEETING OF THE CANADIAN GAS ASSOCIATION.

The fifth annual meeting for the transaction of business, reading of reports, etc., will be held as follows in the Engineers' Club, 94 King Street West, Toronto:—

Tuesday, September 3rd, 9 a.m.—Register at Engineers' Club; Business Meeting; Executive Committee's and Secretary-treasurer's reports; President's Address (Mr. Arthur Hewitt, Toronto); Nomination Committee's report.

Paper by Mr. Howard E. Mann, engineer Montreal Light, Heat and Power Company, Montreal, "Reconstruction of an Old Retort House."

Paper by Mr. H. E. G. Watson, Commercial Department, Consumers' Gas Company, Toronto, "Suggestions for Increasing the Industrial Use of Gas."

12.00 noon—Luncheon.

1 p.m.—The following papers by

Mr. J. J. Armstrong, accountant, Consumers' Gas Company, Toronto, "Consumers' Accounting and Records System."

Mr. C. H. Osler, superintendent of distribution, Montreal Light, Heat and Power Company, "Medium High Pressure Gas Distribution in Montreal."

Mr. C. W. Allman, Commercial Department, Consumers' Gas Company, Toronto, "Gas vs. Coal for Water-heating Appliances."

Mr. W. J. Fuller, Commercial Department, Consumers' Gas Company, Toronto, "Commercial Lighting in Toronto."

Wednesday, September 4th, 10 a.m.—Business meeting at Engineers' Club, announcements, etc.

10.30 a.m.—Sight-seeing trip around the city and a visit to the Canadian National Exhibition.

PERSONAL.

MR. F. G. CLARK, of New York, has accepted a position as chief engineer of the Toronto Electric Light Company.

MR. S. P. PORTER has been appointed executive agent for the Grand Trunk Pacific Railway, with headquarters in Regina, Sask.

MR. GEO. OKXVIK, until recently with the Canadian Bridge Company, of Walkerville, Ont., is now with the city of Toronto in the Department of Railways and Bridges.

PROFESSOR C. C. SLICHTER, Ph.D., of Madison, Wis., U.S.A., has received a commission from the civic authorities of Winnipeg to make a full report on the water supply of that city.

MR. H. E. M. KENSIT, who during the past four years has been occupied in investigating and reporting on various undertakings and projects in Canada and the United States for Messrs. Smith, Kerry and Chace, of Toronto, has received an appointment with the water power branch of the Department of the Interior, Ottawa.

MR. LEROY A. KLING, who has been connected for some time past with two well-known crusher companies in Cedar Rapids, Iowa, has just accepted a position with the Wheeling Mold and Foundry Company, of Wheeling, W. Va., as sales manager of the road machinery department. This is the concern that has built so much of the important machinery for the Panama Canal. They will eventually manufacture a complete line of road building machinery, including a modern crusher, adjustable to crush to any size, pulverizers, rolls, screens, elevators, trucks and graders. Mr. Kling announces that his connection with these people begins at once.

MR. L. J. STREET, vice-president of the Canadian Inspection and Testing Laboratories, and district manager in Toronto for the past eight years, is severing his connection with that firm to go with the Dominion Iron and Steel Co., Sydney, C.B., as assistant to Mr. J. P. McNaughton, general sales manager. For several years Mr. Street was treasurer of the Engineers' Club of Toronto, and on its reorganization a year and a half ago, was elected chairman of its house committee. During his eight years' residence in Toronto Mr. Street has made many friends among the engineers and architects, and by his close application to work and expert attention to large inspection orders handled by him, has done much towards bringing the Canadian Inspection and Testing Laboratories to the high position it occupies in Canada at the present day. Mr. Street's knowledge of the iron and steel requirements of this country should make him a valuable addition to the staff of the Dominion Iron and Steel Co.

MR. JAMES MILNE, recently appointed mechanical and electrical engineer in the Works Department, city of Toronto, has entered upon his duties.

MR. E. M. PROCTOR, who has been with the Canada Foundry for the past two years, has accepted a position in the Department of Railways and Bridges for the city of Toronto. Mr. Proctor is a graduate of the class of '08 in civil engineering of the University of Toronto.

COMING MEETINGS.

CANADIAN GAS ASSOCIATION.—Fifth annual convention will be held in Toronto, August 24th to Sept 9th, 1912, during the Exhibition. Sec'y-Treasurer. John Keillor, Hamilton, Ont.

THE UNION OF CANADIAN MUNICIPALITIES.—August 27, 28 and 29. Meeting at City Hall, Windsor, Ont. Hon. Secretary-Treasurer, W. D. Lighthall, K.C.

CANADIAN FORESTRY ASSOCIATION.—Convention will be held in Victoria, B.C., Sept. 4th-6th. Secy., James Lawler, Canadian Building, Ottawa.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Second Annual Meeting to be held in Toronto, Sept. 16, 17 and 18.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Annual Assembly will be held at Ottawa, in the Public Library, on 7th October, 1912. Hon. Sec'y, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

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.

EIGHTH INTERNATIONAL CONGRESS OF APPLIED CHEMISTRY.—Opening Meeting, Washington, D.C., September 4th, 1912. Other meetings, Business and Scientific, in New York, beginning Friday, September 6th, 1912 and ending September 13th, 1912. Secretary, Bernhard G. Hesse, Ph. D., 25 Broad Street, New York City.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—Sixth Congress will be held in the Engineering Societies Building, 29 West Thirty-ninth Street, New York, Sept. 2-7, 1912. Secretary, H. F. J. Porter, 29 West Thirty-ninth Street, New York.

ILLUMINATING ENGINEERING SOCIETY.—Sixth Annual Convention to be held at Hotel Clifton, Niagra Falls, Ont., Sept. 16-19, 1912. Secretary, Preston S. Millar, 29 West Thirty-ninth Street, New York.

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

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

ENGINEERING SOCIETIES.

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

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

OTTAWA BRANCH—177 Sparks St. Ottawa. Chairman, S. J. Chapleau, 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, 409 Carter Cotton Bldg., Vancouver, B.C. Headquarters: McGill University College, Vancouver.

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

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

MUNICIPAL ASSOCIATIONS

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

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

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

THE UNION OF CANADIAN MUNICIPALTIES.—President, W. Sanford Evans, Mayor of Winnipeg; 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, Mayor Mitchell, Calgary.; Secretary-Treasurer, G. J. Kinnaird, Edmonton, Alta.

UNION OF MANITOBA MUNICIPALTIES.—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.

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, Jas. Anderson, Gen. Mgr., Sandwich, Windsor and Amherst Railway; 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.

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