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# The Canadian Engineer

WEEKLY

ESTABLISHED 1893

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## The Canadian Engineer

ESTABLISHED 1893.

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TORONTO, CANADA, AUGUST 20, 1909.

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**Copy and cuts for changes of advertisements must be in our hands by the Monday preceding date of issue. If proofs are to be submitted, changes should be in our hands at least ten days before date of issue. When advertisers fail to comply with these conditions, the publishers cannot guarantee that the changes will be made.**

## RAILWAY SIGNALLING.

In recent issues of our journal we have been fortunate in securing for publication a few articles on Railway Signalling. These articles have outlined modern methods of protection, and in some cases emphasized the necessity for such protection.

Two kinds of protection are most urgent. First, the public require protection against their own thoughtless acts; and second, the travelling public require protection against the mistakes and carelessness of railway employees. It is to the protection of the second class that the term "Railway Signalling" has become more definitely attached.

A study of the railway accidents in Canada leaves the impression that the public require more protection against their own carelessness than against the mistakes of employees. Three times as many people are killed when trespassing on the track than in all other railway accidents combined. The deadly highway crossing, the open switch, the neglected semaphore and the "I forgot," all combined, cannot tell such a tale of death as does the total of killed when trespassing.

We hear a loud call for subways and viaducts, but if we would encourage and assist the railways in enforcing a "No-trespassing-allowed" law it would be very much more to the point. To secure the enforcement of such a law, more educational work will have to be done, just as it requires much compaigning to prevent people from attempting to board or alight from moving street cars and railway carriages.

Railway signalling is a new art—an art becoming more highly developed and more successful in its application daily. In Canada, we have given the matter but little attention. But public opinion is demanding a higher degree of safety, and railroad officials see the possibility of lessening the loss to rolling stock, decreasing the running time and adding to the safety of employees and passengers by adopting the best methods of signalling and train control.

The number of devices offered for this work is legion. Each week sees one or more new devices patented for which all sorts of ridiculous claims are made, but the useless and unpractical are soon weeded out—a good example of the survival of the fittest.

All the systems devised fall into some one of the following classes: Systems worked without track circuits; systems controlled by track circuits complete in each block; systems with track circuits covering the division.

The perfect system is not yet invented, but signal engineers are improving the practical systems, adding to their knowledge and experience, and they and their inventions are more anxiously sought after.

## A DEPARTMENT OF IRRIGATION.

The closing session of the Western Canada Irrigation Convention was marked by the adoption of a number of important resolutions—resolutions which were a sort of confession of faith of the leaders in irrigation work in the three Western Provinces.

That Alberta needed an agricultural college they were certain, and that the college should be located in the irrigation belt was their dearest wish.

Millions of money was being spent on irrigation schemes. Thousands of settlers are coming to live on the semi-humid lands, and if the best results are to be secured the Government must carry on experiments, distribute literature, and train in their own fields the young men—their young men—anxious to be a successful agriculturist or horticulturist in the irrigated lands belt.

It is to be hoped that Alberta will so locate her Agricultural College that part of the farm land may be irrigated. Raw land in the fertile valleys of the West is now worth from one to two hundred dollars per acre. Even on the great plains the capital invested is so large that only intense farming will bring satisfactory results. It is, therefore, necessary that instruction be given in the practice and theory of the artificial application of water to crops.

As yet we are not educated in irrigation matters. A few of the large farmers and a very few engineers have made some progress in the art in Canada, but the great body of producers are ignorant of the best methods, and every facility ought to be offered so that they may secure the best technical training, and thus be able to make the most of their opportunities.

## RAILWAY COMMISSIONERS' SITTINGS.

The Board has decided to postpone the Operating Sittings, fixed for Ottawa, Ont., Tuesday, September 7th, to Tuesday, September 14th, 1909, at the hour of ten o'clock in the forenoon.

The date for the September Traffic Sittings remains unchanged, and traffic matters will be heard at Ottawa, Tuesday, 21st September, at the hour of ten o'clock in the forenoon.

## GRAND TRUNK CANADIAN DIRECTORATE.

(The Monetary Times.)

Sir Charles Rivers Wilson at Montreal last week gave a shower bath to the Canadian-directorate-for-Grand-Trunk proposal. Every year at the annual meeting the proposition, together with Mr. Fairbairn, a strenuous and eloquent pleader, receives a similar cold douche. Sir Charles stated that no one of weight favoured the innovation. He probably forgot that Sir Robert Perks recently numbered himself as an "Aye," while many prominent business men in London, Montreal, Toronto and Winnipeg would like to witness the change. The Grand Trunk's president sees no objection to a small board of Canadians here. This, we take it, is the proposal. That, and the listing of Grand Trunk stocks on the Canadian Exchanges as suggested by the Monetary Times, would undoubtedly help sentiment so far as it concerns the road. Sentiment is a consideration in relation to earnings. The best way to succeed is to stop harmful discussion. The Canadian directorate will be talked until it comes. The sooner it arrives, the quicker will the chatter cease and will folks get down to business proper.

## EDITORIAL NOTES.

The Canadian Forestry Association are holding a special meeting at Regina, Sask., September 3rd and 4th, 1909. The subjects dealt with will refer particularly to conditions in the Prairie Provinces, and will embrace: Tree Planting on the Eastern and Western Sections of the Prairies, Forest Reserves, Game Protection, Growing Wood for Fuel and for Windbreaks, and the Relation of Forests to the Conservation of Moisture. The speakers will include the best-informed men on forestry subjects in Canada.

The Toronto Street Railway's daily average receipts amount to over one hundred thousand dollars per day. The city's income from their percentage of earnings amounts to over two thousand dollars daily. This is over twice as much as they received from this source five years ago.

## PERSONAL.

MR. E. RICHARDS, B.A.Sc., of the Electrical Department, City Hall, Toronto, is now on a business trip to Great Britain.

MR. PHELPS JOHNSON, chief engineer of the Dominion Bridge Co., Montreal, Que., and Mr. Paul Wolfel, chief engineer of the American Bridge Co., have been called in in consultation by the Quebec Bridge Commission in reference to the plans for the superstructure of the Quebec Bridge.

MR. BENJAMIN R. WESTERN and W. Hull Western, Mr. Walter Mueller and Mr. W. H. Denney have formed the Manufacturers' Publicity Corporation, with offices in the Hudson Terminal Buildings, 30 Church Street, New York.

DR. R. K. McCLUNG, who for the past two years has been in charge of the Physics Department of Mount Allison University in Sackville, N.B., has resigned to accept an appointment to the physics staff of the University of Manitoba in Winnipeg. Dr. McClung is a graduate of McGill University, and after graduating was appointed to a position on the physics staff of that institution. He later spent three years doing research work in physics at the Cavendish laboratory, Cambridge, England, after which he returned to again join the staff of McGill, where he remained until appointed to the professorship of physics in Mount Allison. During the past year he has been engaged on the writing of a college textbook on one of the modern branches of physics, which is at present in the hands of the publisher, and is expected to appear this fall. He takes up his duties in Winnipeg at the beginning of October.

SIR WILLIAM HENRY WHITE, K.C.B., who from 1885 till 1902 was the responsible designer of all the war vessels for the British navy, is in Toronto. Sir William is on his way to Winnipeg, where he will deliver an address at the meetings of the British Association for the Advancement of Science. In addition to having served as president of the Institutes of Civil Engineers and Mechanical Engineers, and as vice-president of the Institute of Naval Architects, Sir William has also written extensively upon professional matters. His chief works are "A Manual of Naval Architecture" and "A Treatise on Shipbuilding." Sir William and his party will remain in Toronto for several days. At present they are in residence at the King Edward.

MR. D. M. SAXBY, of Toronto, has been appointed electrical engineer by the city of Prince Albert, Sask.

MR. T. L. PRENTER, who has been with the C.P.R. for twenty-four years, has accepted the position of assistant manager of the British Columbia Electric Railway. He will have special charge of the Chilliwack branch.

MR. F. C. ARMSTEAD, supervising engineer of the stoker department of the Westinghouse Machine Company, who, for a number of years, has been located at East Pittsburg, Pa., has moved his headquarters to the Westinghouse Works, Attica, N.Y., where the stokers are manufactured.

## ELECTROLYSIS OF WINNIPEG WATER MAINS.

Louis A. Herdt, Ma. E.E.E., Professor of Engineering, McGill.

Pursuant to the resolution of the Council of the City of Winnipeg, which appointed me under date of Jany. 5, 1909, 1909, to report upon the electrical conditions in the City of Winnipeg, particularly in connection with return current of the Winnipeg Electric Railway Company's system and their connection with the Government Telephone Cable System, to report upon the electrical conditions existing in the City of fire standpoint and to submit recommendations dealing with improvements of the present system so that any electrolysis or fire risk, if such exists, may be eliminated, I have the honor to present herewith the following report:

The Winnipeg Electric Railway Company, in operating their street railway system, use the rails as a return for the current operating the cars. In order to make the rails a continuous conductor and thus secure a good return path for the current, the rails are bonded at the rail joints with

copper bonds, besides this the rails are connected to the station negative bus bars by return copper feeders, bonded to the track at different points of the system.

This is the usual method of street railway return construction, but electric railway companies using this system, that is, using the rails as the return circuit for the returning currents, are a serious menace to piping and cable systems in proximity to the tracks, if the methods of constructing the above described rail returns are such that the railway companies are unable to control their own currents, but use the piping and lead-covered cables as part of their return circuit.

### Cause of Electrolysis.

Currents from the railway system, if the track returns are in bad condition, having to find their way back to the power house, will flow from the rails which are in contact with the ground, through the ground and such metallic constructions in it as offer the least resistance to the flow, and after flowing through these (gas pipes, water mains, lead-covered cables, etc.) towards the station, will return through the ground, back to the rails to return conductors in the vicinity of the power house. These stray currents cause electrolytic action, that is, wherever current passes from a pipe or cable to ground, or to another pipe or cable, corrosion of the metal is set up; holes and pittings are produced, causing bursting and leaking of pipes, eating away of the lead-covering on telephone and other cables, rendering them useless. This corrosion may be very rapid and depends on the intensity of the stray currents passing through.

If the rails in a track system were continuous and the current density in the rails kept low, with rails well connected to the power house, the rails would offer such a good return path for the current that street piping, cables and other metallic structures would be practically immune from electrolytic damage due to stray currents. However, as the rails are not continuous but made up in lengths, they must be jointed by copper bonds possessing such mechanical and electrical properties as will secure permanent and efficient electrical continuity of the rails between sections. If such bonding does not exist, and if return feeders connecting the rails to the power house are inadequate for the purpose, the amount of leakage current must be great and electrolysis is bound to exist. The immunity of street piping and other metallic structure from electrolytic damage due to stray currents demands that electric railway companies adopt such method of construction for their track returns as will minimize the danger and the railway companies must maintain the efficiency of such construction through systematic inspection and repair.

In view of the above and in order to arrive at correct and definite conclusions regarding the conditions existing in the City of Winnipeg, a survey for electrolysis and examination of the track piping and cable systems was made.

### Plans Prepared.

Drawings were made as follows:—

Plan No. 1 showing electric railway tracks, high pressure water mains, domestic mains, gas mains, telephone cables—City of Winnipeg. Only those close to or paralleling railway tracks are shown.

This plan also shows districts affected by electrolysis.

Plan No. 2 shows also present lay out of feeders and sections—electric railway tracks, weight of rails, return feeders, bonds, etc.

Plan No. 3 showing localities where damage to water pipes by electrolysis has taken place (from reports of F. A. Cambridge, Esq., city electrician).

### Description of System.

The Winnipeg Street Railway Company have two plants in the City of Winnipeg—one, the old steam plant at the foot of Main Street, corner of Assiniboine Avenue; the other, the sub-station on Mill Street. The first plant is kept as a steam reserve; the second plant, which furnishes the whole of the electric current for the street railway system, receives its electrical energy from the hydro-electric plant at the Pinawa Channel of the Winnipeg River. The average current for the railway service fed out from this plant approximates 6,000 amperes, but reaches as high as 9,000 amperes at times of heavy load in the winter months.

The street railway tracks are bonded at the corner of Main Street and Portage Avenue to return feeders connected to the negative busbars at the station. Other return feeders connected at different points to the track are also used (see Drawing No. 2).

It was apprehended at once from a study of the geographical location of the power station, its distance from the street railway tracks, the large volume of current that required to be returned to it, the run of the underground piping system and the telephone cables (see Drawing No. 1) and the proximity of the river, that unless the track returns were of the very best, and unless there was a very generous amount of copper used for the negative feeders, the conditions were such as to point to great possibilities for stray currents.

### Electrolysis Investigation and Survey.

The electrolysis survey which was carried out, involved not only mere readings of potential difference between the rails, the piping system and telephone cables, but it embraced an examination of the feeding circuits, the general condition of the roadbed and the size and efficiency of the return. A complete and thorough examination of the points where the city electrician had reported damage to the pipes was also made.

The following summary states concisely the conditions existing in the city.

### District Affected by Stray Currents.

The report of your city electrician, a copy of which is attached (Exhibit D), giving location of pipes damaged dating from January 1905 to June 4, 1909, shows that electrolytic action has mainly taken place in the following districts:—

1st—Princess Street, from Logan Avenue to Notre Dame Avenue.

2nd—Portage Avenue, from Hargrave Street to Forth Street.

3rd—District enclosed by Main, Broadway, Hargrave and the river.

4th—Notre Dame Avenue, from Main Street to Winnipeg Electric Railway Company's sub-station.

5th—Ellen Street, from Notre Dame Avenue to McDermot Avenue.

6th—Langside Street, from Portage Avenue to Ellice Avenue.

(These districts are shown shaded on Drawing No. 1.)

Pieces of water pipe and lead covered cables taken from these districts by Mr. Cambridge were examined and showed without doubt that holes and breaks in them had been caused by electrolytic action. (Photos of these attached.)

The damage reported in districts Nos. 1, 2, 5, and 6 is caused by the very bad condition of the bonding on Portage, Notre Dame and William Avenue and Sherbrooke Street tracks. On Portage Avenue, from Hargrave Street towards Sherbrooke, where the roadbed is unpaved, the bond wires, which are Nos. O, B, and S, soft copper wire with bonding cap terminal, give readings in equivalent feet of rail of 20 to 60 feet—this shows very bad condition of bonding. (Readings are given in Exhibit A.)

At several places the bonds are uncovered and many broken bonds were noticed. Current is leaving the tracks in Sherbrooke Street, South Portage and Notre Dame west of Sherbrooke (rails are positive to pipes), entering the pipes, flowing down these until close to Main Street is reached (along Main Street from river to C.P.R. subway, pipes are positive to rails), the current leaves the pipes to rails, telephone cables on other pipes causing the damage reported—it accounts also for the trouble reported in the T. Eaton Company's store. (Report of city engineer, March 2, 1909.

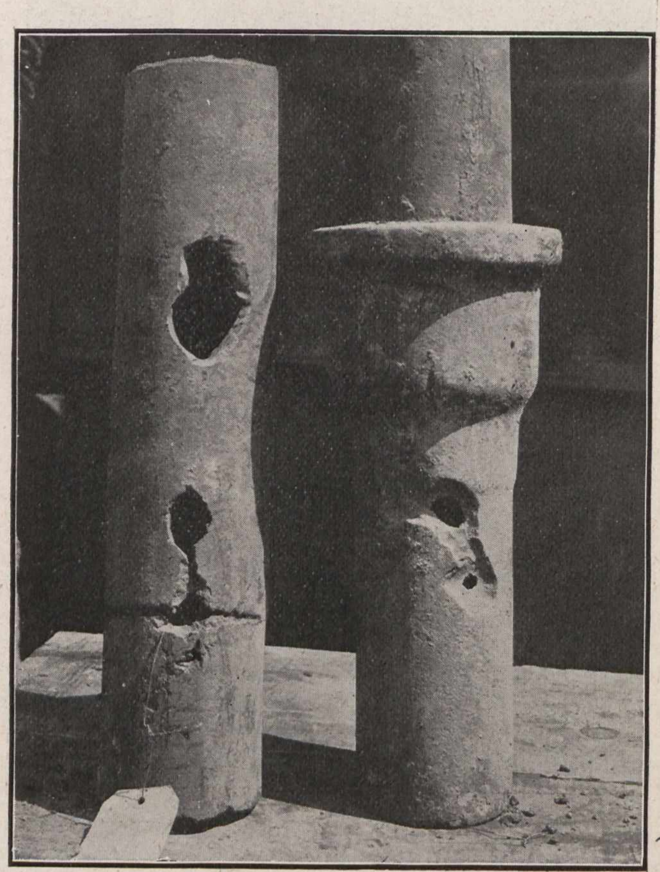
In connection with district No. 3, that is, in the district around the car barns on Main Street close to the river, the rails on Main Street are bonded to the water pipes. The heavy water mains on this street carry a large part of the railway current till it reaches Water Street, Notre Dame Avenue and Portage Avenue East, that is, district No. 4, the stray currents are here given back to the telephone cables which are bonded to the negative bus-bars of the sub-station on Mi'l Street and also to the intricate network of mains and service pipes lying in this district. This accounts for the trouble reported in the McIntyre Block. In this connection, the writer desires to state that on May 26 in company with the city electrician this building was visited. In the basement a recording amperemeter was connected between the water main and the telephone cable. Charts of current readings were kept. At the time of the visit 50 amperes were recorded and the water pipe was positive to the telephone cables. With the statement reported by your city electrician that such a condition involves danger of fire, the writer does not agree, although the conditions there are remarkable enough that conditions might be assumed under which fire could be possible. The remedial scheme referred to above, that of bonding the tracks with water and gas pipes, although it may afford local protection and was considered good practice some time ago, will greatly increase the amount of stray currents and should not be encouraged.

The bonding of the tracks on Main Street from the river to the C.P.R. subway is good. (Readings are given in exhibit "E.") In addition to the rails which are heavy (70 and 95 lbs. to the yard), a 500,000 c. m. cable runs between the rails and is cross bonded to the track. On account of the bad condition of the track returns in the other parts of the city causing stray currents everywhere, the tracts on Main Street, connected to the bus-bars through heavy copper returns, draw the currents from the piping along this street. This is shown by the electrolysis survey, as readings taken along this street between the high pressure hydrants and domestic water pipes show these positive to the rails. As a matter of fact throughout the whole centre of the city this condition is met (see drawing No. 3).

It can therefore be stated that electrolysis is taking place through the entire centre of the city.

### Return Feeders.

The tracks are bonded at the corner of Main Street and Portage Avenue to the return feeders of a total sectional area equal to 6,848,000 circular mills. The drop of potential between this point and the negative bus bars, if these carried the whole railway current would reach 12 volts at



times. The distance is approximately 1,200 feet, that is, the drop of potential from these tracks to the station is one volt per 100 feet. This is altogether excessive, a voltage drop of one-half volt per 300 feet is usually considered large enough. The above condition is responsible for the trouble reported in district No. 4.

### Tracks in Very Bad Shape.

Return feeders, besides the one stated above, are also used (see drawing No. 2), they are bonded to the tracks at different points of the system, but they are of comparatively small section and little current can be carried by them. To sum up it will suffice to say:

1. With the exception of Main Street from the Assiniboine River to the C.P.R. subway, Portage Avenue from Main Street to Hargrave Street, Notre Dame Avenue from Main Street to Charlotte, Corydon Avenue from Pembina Street to Lilac Street, Lilac Street from Corydon Avenue to Woodlaw Avenue and the tracks which are being now bonded with electrically brazed bonds (i.e. Dufferin Avenue and Logan Avenue) the track returns of the Winnipeg Street Railway Company are in very bad shape.

2. The load on the Mill Street substation and its location are such that it is not possible to return through the rails and return feeders only, the large volume of current required for the street railway service.

Electrolytic troubles and damage to the piping system and cables result from these two conditions and is spread out over the whole of the centre of the city, although it has appeared only, so far, in certain districts.

### Recommendations.

The cure for the electrolytic trouble should come from the Electric Railway Company as the city cannot do anything to protect its piping system from stray currents.

Remedial means are mainly those which I have already stated in my preliminary report dated April 1, 1909, and addressed to your secretary, namely:

1. Installation of substations at different points of the system—this with a view of diminishing the amount of current to be returned through the rails in the centre of the city.
2. Proper rebonding of all tracks that show defect.
3. Special bonding and cross bonding work at intersections.

4. A system of inspection of track returns by the railway company.

A substation system of power distribution will do away with the electrolytic trouble. At present the whole current for the railway service being fed from one station, gives rise to a concentration of current in the tracks situated in the heart of the city. The current density in the rail returns must be kept low. The soil in this city shows a very low resistance and only very small difference of potential in rail returns can be allowed. This must be assisted by a rebonding of the tracks which show defects, that is, which indicates excessive drop. All bonds showing a reading of more than 4.5, that is, whose resistance is greater than 4.5 feet of rail should receive attention and be made good. Track intersections should also receive careful attention, ground plates at sides of bridges to carry return currents from one side of river bank to the other must be done away with and insulated feeders placed instead.

### Action By Company.

I am pleased to state that the Winnipeg Electric Railway Company is carrying its work along these lines. Following recommendations made by William B. Boyd, chief engineer, Toronto Railway Company and Toronto Power Company, Toronto, and approved by the writer, the Winnipeg Railway Company have placed orders for electrical machinery, which will be installed in three new substations located as follows: One substation near the car barns at Fort Rouge, another on the line running to the Country Club, approximately 17,000 feet from the Mill Street substation, and the third in the north end of the city near the car barns. This will reduce very largely the amount of current returning through the rails on Main Street. These rails are now very much overloaded with current.

In connection with the rebonding of the tracks, the railway company have now in the city, and in operation, a bonding car for electrically brazing copper bonds on the rail joints. This type of bond, carefully installed, will secure an effective system of rail return. It can be easily applied on old work with very little disturbance of pavements. Tests made on Logan Avenue, where this type of bond is in place, show very low readings of voltage drop. The work being carried out now by the railway company on Dufferin Avenue shows construction work of a very substantial nature and plans for special work at intersections submitted by the railway company to your city electrician and approved by the writer will give intersections with very small drop of potential.

Besides the above, the railway company have advised me through Mr. Boyd, that it is the intention of the company to carry out the following work of reconstruction of their tracks:

1. New rails on Broadway from Main Street to Osborne Street.
2. New rails on River Avenue from Main Street to Osborne Street.
3. New rails on Osborne from Assiniboine River to Spadina Avenue.
4. New rails on Academy Road from Wellington Crescent to Stafford Street.
5. New rails on Notre Dame Avenue from Nena to Arlington Avenue.

The Winnipeg Railway Company must be instructed to proceed with this rebonding work and with the installation of the substations without delay. The rebonding of the tracks must proceed at maximum speed, night and day, until the whole system is in proper condition. After this is done, all bonding of the rails to the telephone cables and pipes should be removed, as well as the ground plates at bridges. The amount of copper in the feeder returns from Main Street, corner of Portage Avenue, to the substation, must be increased to at least 10,000,000 c.m. and the railway company should be instructed to place these wires in the ground in approved conduit.

The writer also desires to recommend that following the termination of the work above outlined, that is, sometime in the fall, a survey be made to see results accomplished.

The third recommendation made, namely, that the railway company should maintain its plant in a high state of efficiency through a rigid inspection of the track returns, is of the greatest importance to the city and should be enforced. The track returns should be under test at all times, in order to remedy at once any faulty bonds as they appear.

Accurate records of the drop of potential at different points of the railway system should be kept by the railway company and be open to inspection of the city electrician.

If the above recommendations are carried out with a desire to obtain best results, troubles due to electrolysis will be practically eliminated. In conclusion, the writer desires to acknowledge his indebtedness to Mr. Boyd for his assistance in this investigation.

The electrolysis tests were carried out by Mr. Beaubien, electrical engineer, Montreal, assisted by Mr. McGinnis, of the Winnipeg electrical department. Respectfully submitted.

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The reconstruction of the Antung-Mukden Railway ordered by Japan will require two and a half years and cost $15,00,000.

## COMPRESSED AIR ENGINEERING.*

**By Frank Richards.**

The employment of compressed air as the agency of power transmission on some of the Barge canal contracts, suggests inquiry as to the advantages and disadvantages of such transmission. Of course, in a way, contractors use their own experience and judgment, and select, and determine their own means and methods, the only ultimate consideration being as to the perfect execution of the work and the complete satisfying of the specifications, but, still, if the means adopted find general approval from the start, the satisfying progress and the winning finish may be more confidently predicted.

The great engineering works of the ancients, and even those of the moderns up to a century ago, were executed, so far as we know, almost entirely by human hands using the primitive tools. To-day if the pick, shovel and the wheelbarrow, backed by the main strength of the laborer, are ever permitted upon works of any extent, the fact calls at once for explanation or apology.

With the advent of machinery as modernly employed, steam was almost universally adopted as the source of power, and subject to the limitation of partially developed mechanical practice, it was applied as directly as possible to the machines to be operated or to the work to be done. For all outdoor engineering work the pumps, the hoists, the pile drivers, the excavators, the rock breakers, the means of haulage and what not, were all directly, and usually individually, steam driven, and apparently no one asked for, or indeed thought of, any radical change or improvement in motive power for such work or in the system of its distribution.

It has always been practically impossible, however, to use steam in mining, in tunnel driving or in subaqueous work of any kind, and practice in these lines developed and improved slowly in conseqence. The rock drill it was which first demanded the air compressor, and the earlier builders of air compressors in large, commercial units found all their business provided for them by rock drills, and quite naturally to-day the largest builders of air compressors are also the principal rock drill makers.

This initial and compulsory employment of compressed air for rock drills in mines and tunnels, and similar work, developed rapidly, compressors became numerous, and practical men began to appreciate the ready applicability of air to the various uses hitherto monopolized by steam. It happens that practically all the apparatus which is operated by air is similar to, if not identical with, that which is steam driven, and all steam driven machines can be driven and generally better driven by compressed air. Where a supply of compressed air has necessarily been provided for the strictly underground machines, and where there have been outdoor machines as part of the same general plant, it has often been a simple matter to pipe the air to the latter also, and thus to have the one power system to cover the entire series of associated mechanisms. Wherever this has been done compressed air has shown itself not only permissible but extremely desirable and profitable, even for the additional items of employment not strictly compulsory.

As to the better drive of air than steam for the same machinery, that is easily demonstrable. Rock drills, whether to be operated by air or steam, are practically identical in design and construction, the only difference being usually in the style of stuffing box used. All drills are run for a considerable time at the factory, to get them broken in and running smoothly and satisfactorily before they are sent out. All the steam drills are first worked with air and after they work all right with that, then steam is used, and it invariably requires long and tedious coaxing before the drills can be made to run as freely and as lively with steam as they did with air. The first admission of the steam causes unequal heating and expansion of the closely fitted members, and also the condensed steam chokes the small and tortuous passages about the valves; also the lubricant which is used, when once it wets the surfaces of the air operated tool, remains a long time, while when steam is used in a drill for only a few minutes, so that it is thoroughly heated if the drill is taken apart and the surfaces supposed to have been lubricated examined, no trace of oil will be found in them, and they will usually be reported "as dry as a bone." The favorable experience with the rock drill, as to the use of air in preference to steam as the operating fluid, is repeated with all other styles of normally steam driven machines. The air operated machine is always and instantly ready and only the throttle requires to be manipulated or thought of.

In driving the tunnels of the Pennsylvania railroad under the Hudson River at New York, it is not conceivable how the work could have been done without the constant aid of compressed air; but for the enormous excavation required for the passenger station of the same company, which was all outdoor work, the use of compressed air was not imperative, but still air was adopted for the work entirely upon its merits by men who knew, and the results have fully proved the wisdom of the choice.

The similar and even more extensive work of excavation for the new station of the New York Central in the heart of New York City, this also entirely outdoor work, is similarly being done entirely with compressed air as the power transmitter.

For engineering works of large extent and the completion of which will require months or years, so as to make the installation of a suitable plant worth while, compressed air is becoming more and more the favorite, where formerly only steam would have been thought of. Some of the largest stone quarries which have promise of permanence of output are now operated entirely from central air compressing plants. The compressed air installations on the Barge Canal at Crescent, at Vischer's Ferry and on the contracts in the western sections are fully warranted by successful engineering experience.

As has happened before in engineering matters and in other things having to do with the world's progress, it has not been the scientific investigators, the official testers of efficiencies, those whose function it is to explain the why of things, who have been the leaders and promoters in this extension of general outdoor compressed air practice. For appreciation and opportunity compressed air is indebted almost entirely to the practical men who have been most closely in touch with it, and now the theorists can pat them on the back and patronizingly assure them that "they builded better than they knew." Perhaps so.

It is by no means difficult, after the practical man has established the practice, to find many cogent reasons which justify the extensive and permanent employment of compressed air. The general impression has been that, while compressed air has many things to recommend it in practice, it is still very wasteful of power, or that the amount of power ultimately realized at the extremities of the piping systems where the air is used is but a small fraction of that which is consumed in the initial compression of the air. The power losses in the use of compressed air have been harped upon until some persons have been able to think of nothing else in connection with it.

The truth is really in the other direction, when the use of air is compared with that of steam for the lines of work we are here considering. It is quite possible to show that the use air compressed by steam at a central station, instead of using steam direct in the individual, widely distributed machines, effects a distinct saving at the coal pile and an enormous saving of operative labor in addition, besides securing the many accompanying minor advantages not generally enumerated and often not even thought of.

Of course, it is an easy thing to cite cases showing how power is wasted by the employment of compressed air for power transmission. Some such occurred early in the compressed air experience of the writer himself. For nearly my first lesson, there was a straight-line, single-stage air compressor running at normal speed and the entire air out-

* From the Barge Canal Bulletin.

put of it was used to drive a steam pump down in a coal mine, the length of piping being not more than 1,000 feet, and the greatest efficiency I was able to figure out in the case, starting with the indicator card of the steam cylinder of the compressor, was 19 per cent. Of course, some of the loss here shown was chargeable to the pump itself, with its large clearance spaces to fill, and the use of the air entirely without expansion. Many cases where the too familiar steam pump is driven by compressed air would show results worse than this, while other types of apparatus so operated might show up somewhat better.

In another case I had a straight-line, single-stage compressor, with piping not exceeding 300 feet, to a small fly-wheel governor, slide-valve steam engine of suitable size. It was possible to adjust the work of the engine—the work was the driving of a fan—and the speed of the compressor so that the one would just supply the other, and each could be brought to a constant running speed. In this case the air passed through a heater by which its temperature was raised 150 degrees Fahr., and its volume correspondingly increased before it entered the engine. The best efficiency I could figure out in this case was 37 per cent.

All who have to do with compressed air can cite instances of power losses such as this, and they would seem to be conclusive against the use of the air, so far as power economy is concerned, were it not for the fact that a decidedly worse case can be made out against the use of steam. In the case where numerous machines are distributed over considerable areas, where the machines are all of them operated intermittently and with constantly varying loads, it is obviously impossible to make tests of power consumption for record or comparison. It is possible, however, to come to some agreement as to probable performance. A hoisting engine may be assumed to be as good an example as any of the machines to be driven. It will probably be fair to assume that the hoisting engine driven by air and working under fair ordinary conditions will, when actually working, realize 25 per cent. of the power consumed in compressing the air. That is, if a horse-power at the compressor costs four pounds of coal per horse-power hour, the coal cost at the hoisting engine will be sixteen pounds per horse-power hour. One important thing in connection with each employment of compressed air is that it costs practically nothing except for the work actually done by it, and only while the work is being done. There are no heat losses and the losses by leakage which we speak of later, are practically negligible. To cover all imaginable losses, however, we may concede an additional 5 per cent., thus allowing the net horse-power realized in work actually done by the compressed air driven machine to be only 20 per cent. of the initial horse-power at the steam driven compressor, and making the coal cost per horse-power hour, therefore, five times as great as at the compressor, or 20 pounds per horse-power hour.

As a matter of record it is quite possible to operate central compressor plants, with compound steam cylinders and condensers, and with boilers and boiler accessories designed and operated for economy, with less than three pounds of coal per horse-power hour. Then five times this, as above, would be only fifteen pounds as the coal cost at the air driven machine.

When water can be utilized as the source of power, with or without the employment of electricity for transmission, the cost which then takes the place of the coal cost must be usually much less, or the water-power would not be employed, and this means that the cost which takes the place of the coal cost at the air driven machine is also less than it would be if steam was employed to drive the compressor, or it would be less than the equivalent of fifteen pounds of coal per horse-power hour.

It is concededly impossible to generate steam at a central station and to transmit it by piping to the several machines to be operated, as we do transmit the air, on account of the constant heat radiation of the line and the consequent losses of condensation, besides the trouble caused by expansion and contraction of piping, water-hammer, etc., the necessity of providing arrangements for trapping or disposing of the water of condensation, and, in spite of all precautions, the frequent stoppage for repairs entailed Each steam operated machine, therefore, must have its own boiler and all appurtenances, its own supply of fuel and water. Such isolated and intermittently operated machines, taking the day through, cost in coal actually consumed at least thirty pounds, and often much more, per horse-power hour of work actually done, or about twice as much as the coal cost of the air operated machine.

With the air driven machine, when the air is piped to it, that ends it, and the operator has only to manipulate the throttle and attend to the lubrication. With the steam driven machine there is not only the cost of the coal actually consumed, but there is also, the bringing of the coal to the machine, the supplying of the water, the firing and caring for the boiler, with all which that implies, so that there is for each machine the labor of a man, or at least the equivalent of one man's labor, to be added to the cost of operating.

The equivalent in coal cost of a man's labor is worth considerable. Say that coal costs at the machine $4 per short ton. Then if the man's wage is $2 per day, that will be 1,000 pounds of coal, or 100 pounds per hour, and for ten horse-power, which is a big allowance for a hoisting engine, this would be ten additional pounds of coal cost per horse-power hour.

So far, then, as the actual cost of the power used is concerned there is evidently a great saving in the employment of air instead of steam, and on this account alone it is no wonder that the knowing ones choose the air transmission, even when there are no special conditions, as in mining, tunneling, subaqueous work, etc., compelling them to do so.

In addition to the saving in coal cost there are other advantages which air carries with it. In the use of steam there is the time taken to fire up and get the pressure before work commences, there is the warming-up process and the working of the water out of the pipes and cylinders every time the machine is started up after standing, none of which delays occur with the air, so that in constant readiness and instant realization of power to the utmost limit required, the air will every day put in from 10 to 25 per cent. more actual work per day. Stuffing boxes will give no trouble; water will not knock out cylinder heads; pipe joints will not be giving out; there will be no chance of low water in the boiler, no burning of flues or crown sheet, no possible blow up. The cost and repairs of maintenance will be much less and the certainty of continuous readiness for work will be much greater. While, as was said, the air-driven machines are identical with the steam-driven type, the individual boilers and all their appurtenances are dispensed with, the cost of them, so far as it goes, helping to offset the larger cost of the compressed air installation as a whole. The saving in repairs and maintenance, with the reduction in the cost of the air-operated machines by dispensing with their boilers, may go to offset the fixed charges entailed in the larger cost of the compressors and piping.

(To Be Continued.)

## OBITUARY.

MR. SAMUEL ROTHWELL, master mechanic of the B. W. and N. W. Railway died at Brockville, August 14th, aged fifty-two. Deceased was a native of St. Catharines, Ont., but spent most of his life in Brockville. Prior to going with the B., W. & N. W. railway he received his training on the G.T.R. and C.P.R., being engaged on the Rocky Mountain construction of the latter line.

MR. EARNEST ALLEN, B.Ss., formerly Ontario representative for the Buffalo Forge Company, has accepted a position as salesman for the Allis-Chalmers-Bullock Company. No territory has been assigned to him as yet. Mr. Allen is a Bachelor of Science of Harvard's technical school, of the class of 1908

# RAILWAY EARNINGS AND STOCK QUOTATIONS

| NAME OF COMPANY | Mileage Operated | Capital in Thousands | Par Value | EARNINGS Week of Aug. 14 | | STOCK QUOTATIONS | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | TORONTO | | | | MONTREAL | | | |
| | | | | 1909 | 1908 | Price Aug. 13 '08 | Price Aug. 5 '09 | Price Aug. 12 '09 | Sales Week End'd Aug12 | Price Aug 12 '08 | Price Aug. 6 '09 | Price Aug. 13 '09 | Sales Week End'd Aug13 |
| Canadian Pacific Railway | 8,920.6 | $150,000 | $100 | 1,586,000 | 1,420,000 | 172 171 | 186½ 186 | 188 187¼ | 331 | 172½ 172¼ | 187 186¾ | 187⅜ 187¼ | 3300 |
| Canadian Northern Railway | 2,986.9 | ........ | ...... | 183,200 | 167,600 | ........ | ........ | ........ | ...... | ........ | ........ | ........ | ...... |
| *Grand Trunk Railway | 3,536 | 226,000 | 100 | 832,475 | 794,562 | ........ | *1st. pref. 105½, 3rd pref. 56⅞, ordinary 24¼ | | | | | ........ | ...... |
| T. & N. O. | 334 | (Gov. Road) | ........ | 30,420 | 18,053 | ........ | ........ | ........ | ...... | ........ | ........ | ........ | ...... |
| Montreal Street Railway | 138.3 | 18,000 | 100 | 77,932 | 73,261 | ........ | ........ | ........ | ...... | 181 180⅜ | 215 214 | 215½ 214½ | ...... |
| Toronto Street Railway | 114 | 8,000 | 100 | 75,999 | 66,917 | 106½ | 126 | 126½ 126 | 270 | 106¾ 106 | 125⅞ 125½ | 126 125½ | 571 |
| Winnipeg Electric | 70 | 6,000 | 100 | ........ | ........ | 162 161 | 187½ 187 | ........ | 6 | 163½ 162 | 187½ 187 | ........ | 6 |

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

## RAILROAD EARNINGS.

Total gross earnings of all United States roads reporting for the first week of August amount to $2,334,133, a gain of 12.5 per cent. over the same week last year, and of 0.8 per cent. over the record year, 1907. Railroad earnings steadily increase, and the immense volume of traffic is gratifying testimony of the near return to normal conditions. In the following table is given earnings of United States roads so far reporting for the first week of August, and the same roads for July; also the more complete reports for July and the two preceding months:—

| | Gross earnings 1909. | Gain. | Per cent. |
|---|---|---|---|
| August (one week) | $ 2,334,133 | $ 259,545 | 12.5 |
| July (one week) | 2,051,179 | 216,464 | 11.8 |
| July | 37,247,812 | 2,274,893 | 6.5 |
| June | 39,317,205 | 3,438,960 | 11.1 |
| May | 38,660,233 | 4,761,111 | 9.6 |

A number of United States roads have now reported for July, total gross earnings of which amount to $37,247,812, a gain of 6.5 per cent. over the same week last year, but a loss in comparison with 1907 of 14.0 per cent. All classes of roads contribute to the increase in the comparison with last year, the gains being most notable in other Eastern, Granger and South-western roads. The statement is printed below:—

| June. | Gross earnings 1909. | Gain. | Per cent. |
|---|---|---|---|
| Trunk, western | $ 5,707,005 | $ 308,914 | 5.7 |
| Other Eastern | 823,510 | 150,881 | 22.3 |
| Central Western | 6,264,183 | 294,905 | 4.9 |
| Granger | 1,711,950 | 133,151 | 8.4 |
| Southern | 13,324,467 | 586,344 | 4.8 |
| Southwestern | 9,416,697 | 800,698 | 9.3 |
| U. S. roads | $37,247,812 | $2,274,893 | 6.5 |
| Canadian | 7,004,000 | 808,000 | 6.5 |
| Mexican | 4,422,621 | 209,000 | 4.9 |
| Total | $48,673,433 | $3,291,893 | 7.0 |

## CALGARY STREET RAILWAY FOR JULY.

| | |
|---|---|
| Earnings | $5,392.77 |
| Expenses | 1,397.41 |
| Profit | $3,995.36 |

## TORONTO AND NORTHERN ONTARIO FOR FIRST HALF YEAR.

Temiskaming and Northern Ontario Railway earnings continue to mount upward. The report for June shows a remarkably good state of affairs. The gross revenue from operation for the month was $131,850. The expenses were $73,648, leaving a net revenue from operation of $58,202. The amount received from ore royalties was $19,273, making the total net receipts $77,475, as compared with $30,573 for June 1908. For the six months ended June 30, the net revenue from operation was $309,174, and from ore royalties $68,355, making a total of $377,529, compared with $55,103 for the same period last year.

## TORONTO STREET RAILWAY.

The Toronto Street Railway Company continues to thrive. The company's receipts in July totalled $239,819.59, this being $28,368.07 in excess of the receipts in July 1908. Figures for the month of July, back to 1904 follow:—

| | |
|---|---|
| July 1909 | $329,819.59 |
| July 1908 | 301,451.52 |
| July 1907 | 305,645.50 |
| July 1906 | 271,217.40 |
| July 1905 | 242,698.60 |
| July 1904 | 213,854.20 |

## NOTE.

The gross earnings of all United States roads reporting for the first week of August amount to $2,334,133, a gain of 12.5 per cent. over the same week last year and of 0.8 per cent. over the record year 1907. Railroad earnings steadily increase and the immense volume of traffic is gratifying testimony of the near return to normal conditions.

## CURRENT NEWS.

TORONTO.—The Armbrust Canadian Brake Shoe Company of Toronto will have an exhibit in the Machinery Hall of the Canadian National Exhibition, consisting of the Armbrust Steel Back Brake Shoes for engines and cars, also Steel Brake Beams and Roller Bearings for freight and passenger cars, and other Railway specialties.

TORONTO.—On September 3rd and 4th a special meeting of the Canadian Forestry Association will be held at Regina, Sask., when subjects having special reference to the prairie Provinces of Canada will be taken up, such as tree-planting on the eastern and western sections of the prairies, forest reserves, game protection, growing wood for fuel and for windbreaks, the relation of forests to the conservation of moisture, etc. The meeting will be opened by His Honor Lieutenant-Governor A. E. Forget. The secretary, James Lawlor, 11 Queen's Park, Toronto, invites all who intend going to communicate with him.

**Catalogues Wanted.**—Messrs. Smith, Kerry & Chace, consulting engineers, of Toronto and Winnipeg, who have recently opened offices at 68 McDougall Block, Calgary, in order to deal more conveniently with their increasing business in that section of the West, would be glad to receive catalogues of electrical and engineering supplies at that address.

THE

# Sanitary Review

SEWERAGE, SEWAGE DISPOSAL, WATER SUPPLY AND WATER PURIFICATION

## SEWER GASES AND DISEASE INFECTION.

We publish in this issue the results of experiments and conclusions by Prof. C. E. A. Winslow, being an examination of the possibilities of disease infection being carried by means of sewer air.

Generally speaking, bacteriologists are extremely skeptical as to the theory that zymotic disease germs leave the body of running sewage, are transmitted to the supernatant air and are carried by that air either up and through vent-pipes or by plumbing defects into buildings.

Certainly all the experiments made in this connection go to prove that the danger of bacterial infection from drain air is but slight. Lately, however, Major W. H. Horrocks, of the English Army Medical Corps, has reported a series of experiments on sewer air to the Royal Society at London. These experiments point to the conclusion that where splashing occurs, bacteria may be thrown into the atmosphere and carried by a current of air. In the natural conditions which exist, however, in a drainage system Professor Winslow demonstrates that the danger of infection from this source is even less than that from drinking the water supplied to New York citizens, which invariably shows the presence of B. coli in ten cubic centimetres.

The conclusions, which we publish, will be read with interest by sanitarians, and apart from the possibility of the direct transmission of sewer bacteria to air, we would call attention to the final paragraph, noting the general possibility of gases from decomposing matter having a predisposing influence upon the body, which may cause it more easily to succumb to specific germs.

The general knowledge that epidemics are not directly traceable to sewer air emanations has brought about a more crucial examination of the role played by flies in carrying infection from exposed sewage collections and the ultimate destiny of the sewage with reference to its possible contact with food supply, especially with regard to water and milk.

**Note.**—The articles appearing in this Review entitled "Sewage Disposal," the first part of which has already been published under the heading "Removing of Solids," the second portion being headed "Removal of Putrescibility," are specially prepared for this Journal by Mr. T. Aird Murray, C.E. We make this announcement as portions of the articles have been reproduced in several technical papers without any recognition of the same. The author reserves the right to publish the articles in book form.

## SEWAGE DISPOSAL—REMOVAL OF PUTRESCIBILITY.

### CHAPTER III.

### Land Intermittent Filtration.

"There can be no doubt that, where the soil is suitable and the area of land sufficient, the organic matters in sewage can be thoroughly oxidised by land treatment." (See fifth Report of the Royal Commission on Sewage Disposal, par. 192, page 137.)

The truth of the above announcement must certainly be admitted; it remains simply a question of suitability of the land and quantity available. The knowledge that sewage properly applied to land will give high purification results is by no means new. We have a capital example of efficient land intermittent filtration in Canada at Berlin, Ont. Here much difficulty was at first experienced in solving the problem of sewage disposal. The sewage of Berlin is exceptionally strong, and rendered complex in character by a large proportion of trade waste effluents. Before any definite scheme was decided upon, several experiments were made with reference to both contact and percolating biological treatment under the auspices of the Ontario Provincial Board of Health. Although several of the experiments gave fair results, considering the characteristic strength of the sewage and the nature and quality of the experiments made, there being a large area of sandy land in the neighborhood, land intermittent filtration was finally resolved upon, preceded, of course, by preliminary removal of solids in settling tanks. These works have continued to give splendid results, and prove conclusively that, with a climate such as exists in South Ontario, land intermittent filtration is a satisfactory method, granted the suitable character and amount of available land.

Before discussing the nature of the non-putrescible effluent rendered by land intermittent filtration and comparing the method and its results with those of artificial biological filtration, it will be well to examine generally what really constitutes a suitable character of land, as well as the area required.

There is no doubt but that efficiency is directly proportionate to porosity, given a sufficient depth of porous soil. Peat land being practically non-porous, is useless, while strong clay is equally so, while the best results are to be obtained by a land consisting almost totally of sand as at Berlin (Ont.) The British Royal Commission publish the result of systematic observations and investigations of land treatment at a large number of so-called sewage farms. The Commission obtained the best results at Nottingham (Eng.), where the soil is a light sand loam and gravel overlying gravel and sand. Here over 10,000 gallons per day per acre are treated, the percentage chemical purification representing a removal of putrescibility of 99 per cent., calculated on oxygen absorbed from permanganate at 26.7° C. (80° F.) in four hours. At South Norwood, where the land consisted of clay soil resting on London clay, only 4,000 gallons per acre per day were treated, and a purification on the above basis of only 81 per cent. was obtained as against 99 per cent. at Nottingham.

The fact that the amount of purification is relative to the character of the soil, led the Massachusetts Board of Health, in the first instance to make the valuable experiments referred to in the last chapter, and prove just what may be done with the soil in that State in the case of land intermittent filtration.

There is no doubt that one of the chief reasons for the generally acknowledged failure of land sewage treatment exists in the past tendency to bring into use any sort of land independent of its suitability. The result of this tendency is extremely unfortunate, and is responsible for a prevailing conceit that artificial biological filtration is in every case superior to land treatment. It is very necessary that this idea shall not prevail in Canada, where land may at times be obtained at very low rates, and where it is often of a very suitable character, especially in the sand districts of South Ontario. It must be remembered that natural sand land presents a biological filter "in situ," and only because of the fineness of the grains and consequent degree of porosity being less than the coarser materials of an artificial filter, it consequently requires a larger area to deal with the volume of liquid accompanying the sewage.

Referring again to the Laurence experiments, especially with reference to soil examinations, the method adopted of arriving at the size of the particles constituting the bulk is of interest. The soil is first dried, and then passed through sieves of the following meshes: 10, 5, 2, 1, 0.5, 0.25, and 0.1 mm. Five grammes of the finest of the above samples are mixed in a glass tube containing 200 c.c. of distilled water, being thoroughly mixed by forcing air through the tube. After fifteen seconds of settlement, the supernatent liquid is drawn off, the sediment representing particles 0.1 to 0.05 mm. The liquid undergoes a similar mixing process, and is allowed further settlement for thirty seconds. the particles precipitating being regarded 0.05 to 0.03 mm. The process is again repeated with sixty seconds' settlement, leaving a sediment varying from 0.03 to 0.01 mm. Any remaining sediment is regarded as organic matter. All the samples are dried at 105° C. until constant in weight. This method presents eleven portions or sizes. The total weight of the portions is equal to the weight of the dried soil originally taken, less a slight loss due to the process.

An examination of the material used in Filter No. 6 gave the following sizes:—

| | | | | | |
|---|---|---|---|---|---|
| Size in m m., less than...... | 12.6 | 6.2 | 2.2 | 0.98 | 0.46 |
| Per cent. ................ | 83 | 73 | 57 | 32 | 13 |
| Size in m m., less than.... | 0.24 | 0.12 | 0.06 | 0.03 | 0.01 |
| Per cent. ............. | 7 | 4 | 2 | 0.05 | 0 |

The effective size of the material constituting the above filter will be found between the sizes 0.46 and 0.24, viz., 0.35 representing the 10 per cent. curve below which the remaining sizes are smaller than 0.35. The uniformity coefficient works out at 7.8, representing the 60 per cent. curve divided by the effective size. Very coarse soil may give a uniformity coefficient as ten or more, and a very fine soil two or less. The best soil for land intermittent filtration is to be found with an effective size of 0.3 mm. and a uniformity coefficient between two and five. The latter more nearly represents the material used in the Laurence Filter No. 4.

The materials composing soils may be separated with reference to the diameters of the particles as follows:—

| | mm. | | mm. |
|---|---|---|---|
| Grits of fine gravel with diameter...... | 2.0 | down to | 1.0 |
| Coarse sand with diameter ........... | 1.0 | " | 0.5 |
| Medium sand with diameter............ | 0.5 | " | 0.25 |
| Fine sand with diameter............... | 0.25 | " | 0.10 |
| Very fine sand or dust with diameter... | .10 | " | 0.05 |
| Silt with diameter .................... | 0.01 | " | 0.005 |
| Clay with diameter .................... | 0.005 | " | 0.0001 |

Given the effective size and uniformity coefficient of a soil, a deductive examination and comparison with the above diameters will give an approximate idea of the character of the soil in question. For example, in the case of the Lawrence Filter No. 5, the effective size of which was 0.02 mm. and the uniformity coefficient 9.0, it is not difficult to arrive at the conclusion that the material was composed of fine river silt mixed with coarser material, the effective size, 0.02, being quite unsuitable, causing the spaces between the coarser material to become clogged

The water-retaining capacity of a soil is of great importance in land intermittent filtration. In this relation the remark previously made "that efficiency is directly proportionate to porosity," requires qualifying. If a quantity of soil be first dried, and then dosed with water, it is only capable of holding up or retaining so much of the water, the balance percolating through the soil. The volume of water capable of being retained after the excess has been allowed to thoroughly drain away is equal to the water-retaining capacity. Soils which are suitable for filtration as far as their effective sizes and coefficient values are concerned present a water-retaining capacity of from 16 to 18 per cent. of the volume occupied by the soil.

If the effective size is too large, the water-retaining capacity is too small, and sufficient time is not allowed for absorption of the organic matters, the latter passing away into the under-drains unoxidized. On the other hand, if the effective size is too low, as in the case of Lawrence Filter No. 5, the water-retaining capacity is too great, resulting in clogging and flooding of the surface with a cessation of oxidation.

The results of the Lawrence experiments, and, in fact, all experiments, prove that the volume of sewage applied either to land or to percolating biological filters at a single dose should in no case exceed the water-retaining capacity. This, theoretically, means that every dose of sewage pushes downward the retained previous dose, taking its place, and remaining, during the intermittence of time, in contact with the soil, during which period organic matter in solution is absorbed. The following works of land intermittent filtration have been installed in the State of Massachusetts as the result of the Lawrence experiments:—

| Name of town. | Population. | Date at which works were introduced. |
|---|---|---|
| Framingham ...................... | 7,000 | 1888 |
| Andover ......................... | 6,813 | 1893-94 |
| Clinton ......................... | 13,667 | 1898-99 |
| Concord ......................... | 5,652 | 1898-99 |
| Gardner ......................... | 10,813 | 1891 |
| Leicester ....................... | 3,416 | 1894 |
| Marlborough ..................... | 13,609 | 1890-91 |
| Nalick .......................... | 9,488 | 1895-06 |
| Pittsfield ...................... | 21,766 | 1890 |
| Westborough ..................... | 5,400 | 1891-92 |
| Worcester ....................... | 118,421 | 1890 |

The Framingham sewage works have been in work for twenty years, and others for almost similar periods. Framingham in 1903 discharged an average of 542,000 gallons of sewage per day, including trade waste effluents, representing 33,000 gallons from color works and 15,000 gallons from a hat factory. The sewage is first treated in a collecting chamber of a capacity equal to 350,000 gallons for the removal of solids. The land occupied is about 100 acres in extent, but only about twenty acres have been brought into use for intermittent filtration, this being divided into eighteen plots or filters. The soil is of a coarse, gravelly character. Eleven of the eighteen plots are underdrained at a depth of six feet. The effluent from the undrained filters shows itself by springs along the river banks. Throughout the year the amount of sewage treated is equal to about 0.03 cubic yard per square yard of area. The rate of filtration per acre is about 27,000 gallons per acre per day. The beds are ploughed each year and planted with maize. When cutting the maize in autumn six inches of stalk is allowed to remain, which tends to support the ice in winter, the filtration going on under the ice.

The sewage reached the works from January to May, 1903, at a temperature of 7.2° C., rising in June to 8.9°, and reaching a maximum of 15.5° in August. The average analysis of both the raw sewage and effluents are here given for 1903:—

We may judge of the purification shown by the above analysis by considering the effluent from the eastern drain; the other effluents show higher purifications. With the former we have a 92.6 per cent. as regards free ammonia, 97.1 per cent. albuminoid ammonia, and 93.2 per cent. in the oxygen absorbed. Even during the coldest months the percentage absorbed in the oxygen absorbed is 90.9.

It cost $10,500, including drainage, to level and prepare the surface of the twenty acres. The total cost was:—

| | |
|---|---|
| Collecting chamber (capacity, 358,500 gallons and rising main) | $40,775 00 |
| Pumping station | 15,650 00 |
| Pumps (capacity, 1,665,400 gallons per day) | 6,925 00 |
| Purchase of land (100 acres) | 6,625 00 |
| Construction of filters (twenty acres) | 10,550 00 |
| Total | $80,525 00 |

The maintenance is very small, as laborers are only employed part time. The maize crops realize $85 per annum profit. The working expenses at the pumping station amount to $4,250 per annum.

The splendid results obtained at Framingham, and, in fact, at the works generally in Massachusetts, are due to the excellent work done by the State Board of Health, which does not only examine the plans for proposed schemes, but supervises the construction of the works and inspects the working capabilities from time to time.

Unfortunately in Canada our Provincial Boards of Health have not powers equal to the State Boards of Health on the other side. In fact, as far as being effective machines in controlling municipal health engineering problems, up to the present they have been a mere farce.

The Royal Commission have to state, par. 195, page 143, Fifth Report: "Generally speaking, the evidence points to a maximum rate of 30,000 gallons per acre, or 1,000 persons per acre (this at the rate of thirty gallons per head per day) with the best land after preliminary treatment, although some witnesses put the rate as high as 60,000 gallons per acre. With unsuitable land, such as clay, not more than 3,000 gallons per acre can be efficiently treated, even after settlement of solids.

It will be noted that the volume treated at Framingham, Mass., is 27,000 gallons per acre per day, and at Nottingham, England, 10,700 gallons, and at each place good results were obtained. The present writer's experience with land intermittent filtration, which is considerable, is that with the best of land 30,000 gallons should never be exceeded. At Brockton, Mass., where an average of 731,060 gallons of sewage is successfully treated by land intermittent filtration, twenty-two acres of land is utilized. This gives a rate of 22,000 gallons per acre per day. The land is divided into twenty-three filter beds, and the average daily quantity of sewage dealt with by a single filter was 23,540 gallons. On the average they received a dose of sewage every third day, some as many as 168 doses a year, and the average volume of sewage per dose was 70,000 to 90,000 gallons. Sometimes as much as 130,000 gallons was discharged to a filter at one time, and the maximum volume so discharged was 222,000 gallons. One filter received 440,000 gallons on one occasion. It is probable that on no occasion should any one filter have received a dose of over 200,000 gallons at one time, as we see that each filter was under an acre in area.

CHEMICAL ANALYSIS OF FRAMINGHAM CRUDE SEWAGE

(Yearly Average of Monthly Analyses.)

(Parts per 100,000)

| Total Solids: Total | Total Solids: Loss on Ignition | Solids in Solution: Total | Solids in Solution: Loss on Ignition | Solids in Suspension: Total | Solids in Suspension: Loss on Ignition | Ammonia (N.H.3): Free | Ammonia, Albuminoid: Total | Ammonia, Albuminoid: In Solution | Ammonia, Albuminoid: In Suspension | Chlorides | Oxygen Absorbed: Total | Oxygen Absorbed: N Solution |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 58.77 | 29.88 | 37.53 | 13.66 | 21.24 | 16.22 | 17 | 0.79 | 0.41 | 0.38 | 6.99 | 4.67 | 2.69 |

CHEMICAL ANALYSIS OF EFFLUENTS FROM FRAMINGHAM SEWAGE

(Yearly average of Monthly Analyses)

(Parts in 100,000)

| | Total Solids | Ammonia (N.H.3): Free | Ammonia (N.H.3): Albuminoid | Chlorides (Cl) | Nitrogen: Nitric | Nitrogen: Nitrous | Oxygen Absorbed | Iron |
|---|---|---|---|---|---|---|---|---|
| Eastern Drain | 29.15 | 0.236 | 0.023 | 5.32 | 1.002 | 0 017 | 0.31 | 0.044 |
| Western Drain | 27.87 | 0.198 | 0.015 | 5.03 | 0.969 | 0.013 | 0.21 | 0.028 |
| Spring | 21.06 | 0.0004 | 0 002 | 3.81 | 0.910 | nil | 0.04 | 0.005 |

The results of the Massachusetts efforts told in words make land intermittent filtration appear to be a very simple process. An intermittent filter must be treated, however, like a living thing. If it is overfed, its digestion is interfered with. The equilibrium between absorption and oxidation must be maintained. A filter will become accustomed to a certain dose, and even to a certain character of sewage. Data affecting the highest possible efficiency in each case must be obtained and the filters worked accordingly.

With reference to the question of the area of land required, of course this must depend entirely upon the character of sewage as well as upon the character of the land. Within certain limits the strength of a sewage, independent of the volume treated, affects the efficiency of artificial biological filters. This, however, is not so in the case of land. Land consisting of fine grain material is incapable of dealing with comparatively large volumes of liquid apart entirely from the work to be performed in oxidizing the sewage matter.

Assuming a sand soil with an effective size (0.3 mm.) and a uniformity coefficient of five, the underdrainage being placed six feet deep, each square yard of land would then represent 54 cubic feet of filtering material. Sixteen per cent. of this, or about eight cubic feet, would represent the water-retaining capacity. Such a soil at an acre in area per filter should, therefore, never receive above 240,000 gallons at a single dose. In the case of Brockton, the average purification for the year 1903 was by the oxygen absorbed test 98.5 per cent.

(To be continued.)

## BACTERIA IN SEWER AIR.

Prof. C. E. A. Winslow.*

The idea of the connection between sewer gas and disease dates back to the days when the cause of the infectious maladies was still unknown. Mysterious miasmatic influences were naturally enough supposed to accompany the foul odours of decomposing organic matter. When it was proved that the contagious and infectious diseases are due to the presence of microscopic plant and animal parasites, the case against sewer gas seemed less convincing.

Nageli and many other bacteriologists showed that under ordinary conditions germs adhere strongly to moist surfaces, and are not easily given off from liquids into the adjacent air. Sir Edward Frankland in England, and Raphael Pumpelly in this country carried out experiments which indicated that chemicals in solution, and bacteria in suspension, might be thrown into the air from liquids by the bursting of bubbles. On this contingency the possible danger of sewer gas infection still might rest.

Actual examinations of the air in sewers, however, by Miquel in France, Petri in Germany, and Carnelley, and Haldane, Robertson and Laws and Andrewes in England, showed that sewer air as a mattter of fact contains very small numbers of bacteria, and those of types common in street air rather than in sewage. Uffelmann found the same condition in the air of a house drainage system. Carnelley and Haldane, and Laws and Andrewes isolated sewage bacteria in the immediate vicinity of points where active splashing occurred. As in the experimental studies of Frankland, Pumpelly and Dr. Abbott, of Philadelphia, there was clearly a possibility of air infection where spray was produced by some mechanical method. On the whole, however, the air of drains and sewers seemed to be of high bacterial purity, and all the observers who studied normal conditions in actual sewers concluded that the danger of bacterial infection from sewer air was remote.

These results, with the absence of any reliable evidence from the study of epidemics in favor of the transmission of germs by sewer air, has led sanitarians in Germany and the United States to agree with practical unanimity that the danger of such transmission may be disregarded. In England, on the other hand, a large number, probably a majority, of sanitary experts have failed to be convinced, and have clung to the opinion that under some conditions the carriage of disease bacteria by sewer air is a practical possibility.

A little over a year ago, at the request of the National Association of Master Plumbers, I made some experiments on this problem, upon which no practical investigations had been conducted for over ten years. I used an experimental stack of 4-in. soil pipe, 15 feet, in height, with a running trap at the bottom and an exhaust fan, for drawing up a strong current of air, at the top. Sewage was placed in the trap, sealing it partially or completely, or resting in the bottom without sealing it. Air was drawn over the sewage and wetted surfaces of the pipe, or was bubbled through the sealed trap, and the air was examined at various points in the stack above. When the air current was strong, an increase was noted in the bacterial content of the pipe air; but the increase was not striking even at high velocities, and was entirely wanting with air currents of less extreme force. Only three of the characteristic bacteria of sewage were isolated from the air in the whole series of experiments. As a result of this investigation I reported that the danger of bacterial infection from drain air was but slight.

At about the same time a series of experiments on sewer air was reported to the Royal Society of London by Major W. H. Horrocks, of the English Army Medical Corps. His results seemed at first sight to warrant widely different conclusions from those drawn by other observers; and it seemed necessary to re-examine the whole question with the greatest care.

Major Horrocks's general method consisted in the artificial infection of the lower part of natural and experimental drainage system with a peculiar bacterium, the Bacillus prodigiosus, which is not normally found in the air. He then exposed small open dishes of nutritive media (Petri plates) in the upper part of the systems. Germs carried up in the air fell on the plates grew and developed into visible colonies, and among these colonies he identified the particular form, Bacillus prodigiosus, introduced in the liquid at the bottom. By this process he detected his test organism in a pipe 9 feet above an experimental running trap into which it had been introduced, and in the air of a catch basin of the town into which he had poured it. Similar results were obtained when the lower sections of his experimental pipe system were wetted with a culture of the Bacillus prodigiosus and then dried. The dried germs were apparently detached, carried up by the air and deposited on the plates. In another series of experiments sewage infected with typhoid bacillus, or with Bacillus prodigiosus, was allowed to flow, quietly and without splashing, through a horizontal pipe to which a vertical pipe was connected at an intermediate point. Plates exposed in the vertical pipe showed colonies of the specific bacteria introduced below, even at a height of 11 feet 9 inches, above the liquid. Again, emulsions of Bacillus prodigiosus were flushed from the closets of drainage systems in actual use, and germs thus introduced were found in all parts of the systems in open connection therewith, even at a height of 50 feet above the traps. Major Horrocks, by the same method of exposing Petri plates, found Bacillus coli, the characteristic organism of sewage, in a house drain and in the main sewer of the town. Finally he passed the feces of a typhoid patient suspended in water through a half-S trap, and found the typhoid organism on plates in a vertical pipe above it at a height of 3 feet 6 inches above the liquid.

Major Horrocks's report, and still more recent series of confirmatory experiments by Dr. F. W. Andrewes of London naturally excited the deepest interest among sanitarians. In many quarters the old suspicions of sewer air were revived in almost their full force.

The Journal of the American Medical Association, for example, said in commenting upon Horrocks's work: "We may still have to look to sewer emanations as the occasional cause of mysterious outbreaks of disease." The other sanitarians maintained a more conservative attitude, and waited further evidence before abandoning their previous conclusions. The matter stood about as follows: On the one hand, Horrocks had shown that specific bacteria, present in traps and drains, could get into the air above by splashing, by the bursting of bubbles, and even in some experiments from the surface of liquids apparently in quiet motion; he detected such bacteria by the plate method in the air of ventilating pipes at considerable distances (once at 50 feet.) above the infected liquid. On the other hand, Miquel, Petri, Uffelmann, Carnelley and Haldane, Laws and Andrewes, and others, had shown that the number of bacteria actually present in the air of sewers and house drains is extremely small, and that those present are generally air forms and not sewage forms. Furthermore, reliable evidence of the spread of infectious disease by sewer air is wholly lacking. In the inconsistency of the two sorts of evidence required in explanation; and, after presenting the facts to the Sanitary Committee of the National Association of Master Plumbers, I was commissioned by them to attempt the clearing up of the apparent contradiction.

I first attempted to repeat as closely as possible one of Horrocks's simpler experiments. I examined the air of a boat chamber on one of the main sewers of the city of Boston, as Horrocks had done in the sewers of Gibraltar. I found colon bacilli, the characteristic sewage organism,

*Of the Massachusetts Institute of Technology to the National Association of Master Plumbers of the United States.

on my plates in many experiments; but their number was least nearest the sewage, greater nearer the street, and greatest in the street air itself. It was clear that they came from street dust infected by horse dung, etc., and not from the sewage at all. I then constructed an experimental pipe system, such as Horrocks used, consisting of a half-S trap of 6-inch tile drain, to which an 8-foot vertical stack of the same pipe was connected. A rich emulsion of Bacillus coli culture, in soapy water was poured through the trap and Petri dishes of nutrient gelatin or agar were suspended at various points in the pipe above. Control plates were also exposed at various points in the laboratory outside. Six out of twenty-eight plates exposed in the pipe over the Bacillus coli emulsion showed colonies of this germ, fourteen colonies in all. Eight out of the twenty-four plates exposed in the pipe over the liquid infected with Bacillus prodigiosus showed this organism, seventeen colonies in all. The general effect of these experiments was, therefore, to confirm the results of Major Horrocks. My tests, like his, showed that specific bacteria are discharged into the air from the surface of foaming infected liquids, and may be carried up in connecting pipes for considerable distances. Furthermore, I found that the velocity of an air current capable of transporting bacteria in the form in which they are sprayed into the air from an atomizer is very low indeed.

Granting, then, that infection of the air above sewage may take place, how can the results of actual examinations of sewer air be explained? The idea suggested itself at once that the whole question might be a quantitative one. It might be possible that under extreme conditions sewage bacteria get into the air, but that the number discharged is so small under normal conditions that it does not appreciably affect the composition of the air of the sewer as a whole.

I next, therefore, attempted to investigate the question from this stand point and made first a careful examination of the best available quantitative methods. Horrocks's procedure of exposing open dishes of nutrient media to the air is, of course, not quantitative at all, since the bacteria which happen to fall on the plate are not related to any particular volume of air. The method adopted by most recent observers, and the one which I used in experiments reported a year ago, involves the straining out of the bacteria in a measured volume of air by drawing it through a sand filter. The bacteria are then washed out from the sand in sterile water and enumerated by the ordinary cultivation methods. During my work this year I developed a new method in which a measured volume of air is drawn into two large culture bottles, and the bacteria are allowed to settle out and form colonies of nutrient media in the bottom of the bottles. This method, although cumbrous, avoids all danger of losing bacteria by drawing them through the sand, and was used in all my latter work. A careful series of comparative tests, showed, however, that the sand method used in other investigations is essentially accurate, and earlier results may be accepted as correct in their general conclusions.

By the use of the culture bottle method I next attempted to control Major Horrocks's results from the quantitative standpoint. I prepared a rich emulsion of Bacillus prodigiosus, containing hundreds of millions of bacteria per litre, made it foam freely by beating it up with soap, and poured into a large glass bottle, or into anopen dish. The air in the bottle, or the air of the laboratory over the open dish, was examined by the culture bottle method. Out of thirty litres of air examined, five only contained Bacillus prodigiosus. In one litre three were found, and in the other four one each. Clearly the bacterial infection of the air produced by very vigorous foaming was but slight.

In these experiments there was but little splashing of the infected liquids; the bursting of bubbles from the foaming surface was the only source of air infection. I next imitated natural conditions more closely. Through the kindness of Mr. Craig I had an ordinary porcelain water-closet bowl set directly on a 4-inch cast-iron S trap, having a clean-out hole at its crown. The S trap was connected at its lower end with an ordinary 4-inch running trap. A rich soapy emulsion of Bacillus prodigiosus was poured rapidly into the water closet bowl, so as to rush down through the two traps, foaming and splashing as it went. Samples of air were collected from the clean out at the crown of the upper trap, and from the upper opening of the lower running trap, a few inches only from the foaming surface of the liquid. Everything was as favorable as possible for the discharge of bacteria into the air. Yet, out of forty-four litres of air examined, forty-three contained no Bacillus prodigiosus. One litre showed a group of eleven colonies apparently derived from a single infected droplet. It must be remembered that in these experiments I used liquids artificially infected with large numbers of specific bacteria, and caused foaming artificially by beating them up with a considerable addition of soap. Vigorous splashing was added to foaming in the last series of tests. Under these extreme conditions, as in Major Horrocks's experiments, the specific bacteria present could be detected in the air; yet the actual number present even here was extremely small.

These experiments seemed to offer a reasonable explanation of the difference between Major Horrocks's rsults and those of other observers. Bacterial infection of the air from foaming liquids may take place. Horrocks, using for the part artificially prepared emulsions and ignoring the quantitative aspect of the case, naturally obtained positive results. When the question is approached numerically, however, the amount of air infection, even under extreme conditions, is so slight that one would scarcely expect the general air of sewers and house drains to be appreciably affected under normal conditions.

The final test of experimental conclusions of this sort must always be made by an appeal to existing conditions under normal circumstances of actual use. The numerous investigations cited above have shown that the air of street sewers is indeed singularly free from bacteria. The air of house drainage systems might, however, be supposed to be worse than that of the street sewer; and with regard to their bacterial condition only the single report of Uffelmann appears to be available. As a crucial test, I therefore determined to carry out a sufficient number of examinations of house drain air to gain a fair idea of its bacterial composition. With the cordial co-operation of Mr. Craig, I have been able to complete this work and to obtain results which seem to be conclusive.

I studied nineteen different plumbing systems, five in buildings of the Massachusetts Institute of Technology, four in the wards of the Boston City Hospital, three in a block of East Boston tenements, two at the Boston City Hall, two at the Hotel Lenox, and one each in the Ames Building, in the Technology Club, and in a private residence on Newbury Street. The plumbing pipes were tapped at various representative points, on the main stack in the lower part of the building, on the projection of the main stack above the roof, on clean outs on the main house drain, or wastes from fixtures and dead ends in connection with the house drain, and in one case on the stack. From each of twenty points selected, ten litres of air were drawn off and examined for the characteristic bacteria of sewage, the colon bacillus and the sewage streptococcus.

In all, 200 litre samples of air were examined. Three samples were lost from the fact that the liquid sewage in the plumbing pipe ran into the collecting tube and over into the culture bottle, directly contaminating it with liquid. There remained then, 197 tests. Of these 193 showed no sewage bacteria present. In the remaining four cases, sewage organisms were found, the colon bacillus three times, and the streptococcus once. In each one of these four cases there was a discharge of sewage in the pipe at the point of examination, and at the moment the sample was taken, so that spray was actually splashing in the air. In each of the four cases a sample of air from the same point ten minutes later showed no sewage forms present. In not a single case out of the 200 were sewage bacteria present in a litre of house drain air, unless there was mechanical splashing at the point, and at the moment of examination.

In general my results confirm the results of Horrocks, in so far as they show that specific bacteria may be ejected from liquids into the air above. My tests of house drain air, like those of Carnelley and Haldane and Laws and Andrewes on sewer air, indicate that mechanical splashing may produce a local infection of the air in immediate contact with the spray. Such an infection does not, however, extend for any distance or persist for more than a minute or so. I found the general air of house drainage systems singularly free from bacterial life. Out of 200 litres examined, only forty-eight contained any organisms capable of development at 37 degrees. Sewage bacteria were found in the air of the house drains only four times out of 200 litres, and then in the presence of mechanical spraying of sewage at the point of collection. The general air of the house drainage system, aside from this local infection, was, as far as examined, free from sewage organisms. These results accord well with those obtained by Miquel, Petri, Carnelley and Haldane and Laws and Andrewes in street sewers, and with those reported by Uffelmann for drain air.

The experiments of Major Horrocks, rightly interpreted, in no way contradict this general concensus of opinion. He demonstrated a possibility by using, for the most part, artificially infected and foaming emulsions, and by ignoring all quantitative considerations. We must deal, however, in sanitation, not with theoretical possibilities, but with probabilities, measured as closely as possible in regard to their practical importance. I have found in my experiments that even under the most extreme conditions the number of bacteria which get into the air from an infected liquid is small. I have found by the examination of a series of plumbing systems in actual use that intestinal bacteria could only be isolated four times out of 200 litres, and then only at points of direct local infection from splashing.

In a surface water of good quality, like that of New York City, the colon bacillus can almost invariably be isolated from 10 cubic centimetres. This means a slight degree of intestinal pollution, but experience has shown that the chance of infection from such a water is but slight; and we drink it without serious alarm. If one were to breathe for twenty-four hours the undiluted air of a house drainage system, at any point not immediately infected by mechanical splashing, it appears that less than fifty intestinal bacteria would be taken in, for the daily consumption of air is about 10,000 litres, and in 200 litres I obtained negative results from air of this sort. In drinking New York water, twice as many colon bacilli are ingested every day, for 1,000 cubic centimetres is a small amount for daily consumption. So there would be less danger of contracting disease from continually breathing the air of a vent pipe, or a soil pipe, except where liquid is actually splashing, than from drinking New York water.

There is a possibility, of course, that the gaseous emanations from decomposing organic matter may exert a predisposing organic influence which makes the body succumb more easily to specific germs, introduced in other ways. Many have held that in this way sewer gas might indirectly promote disease. This view, supported mainly by the experiments of Alessi, well deserves further study; but I have not dealt with it in the present investigation. I believe, however, that my results in the light of all previous evidence, warrant the conclusion that the chance of direct bacterial infection through the air of drains and sewers is so slight as to be practically negligible.

H. Walters & Sons, of Hull, are formed into a joint stock company to manufacture axes and tools. The incorporators are J. E. Gravelle, of Hull; J. G. Walters, N. P. Walters, James Walters, H. J. Thomas, of Ottawa, and the capital stock is $350,000.

## ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

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

7645—July 27—Authorizing the Brantford Gas Company to lay and maintain a three-inch gas main under the track of the Toronto-Hamilton and Buffalo Railway at Oak Street, Brantford.

7646—July 23—Directing C.P.R. to forthwith erect, maintain and operate station at the village of Wattsburg, B.C., known and described as its Standard No. 6 station.

7647—July 27—Approving basis of Standard Passenger Tariff of the Quebec Railway, Light and Power Company, C.R.C. No. 8, 2½c. per mile.

7648—July 26—Authorizing the City of Toronto to lay and maintain water pipe under tracks of G.T.R. at Royce Avenue, Toronto.

7649—July 26—Authorizing the City of Toronto to lay and maintain a water pipe under the tracks of the C.P.R. at Royce Avenue, Toronto.

7650—July 27—Authorizing the Pere Marquette Railway Company to remove the east derail at Walkerville Junction, Ont., to a point 495 feet from the crossing.

7651—July 27—Approving plan and profile of proposed crossing of the municipality of Johnston, Tarbutt, and Tarbutt additional over the Soo branch at or near mile post 148 between Lots 4 and 5, Concession 6, Township of Johnston.

7652—July 27—Extending until December 1st, 1909, the time fixed by Order of the Board 6804 dated April 6th, 1909, for the installation of the interlocking plant of the C.P.R. at Drumbo, Ont.

7653—July 26—Refusing application of the City of Toronto for leave to construct additional bridge across the tracks of the C.P.R. and G.T.R. at Dundas Street.

7654—July 26—Authorizing the C.P.R. to construct, maintain and operate two branch lines of spurs into the premises of R. Gordon, Arcola, Sask.

7655—July 22—Reopening for consideration at the first sitting of the Board in Hamilton or Brantford, Ont., the application of the Toronto, Hamilton and Buffalo Railway, for Order to renew, reconstruct or alter the highway bridge under which the railway crosses the public highway in the Township of Brantford, at a point about three miles east of Brantford, Ont.

7656—July 27—Approving location of Canadinan Northern Railway through Townships 10-9, Ranges 30-32, West Principal Meridian, Province of Saskatchewan, mileage 0 to 16.09.

7657—July 24—Approving Canadian Northern Quebec Railway Tariff of Sleeping and Parlor Car Rates, C.R.C. No. S.I.

7658—July 24—Approving Canadian Northern Ontario Railway Standard Tariff of Maximum Parlor Car Tolls, C.R.C. S. 4.

7659—July 24—Approving C.P.R. Standard Tariff of Maximum Sleeping and Parlor Car Tolls, C.R.C. No. S.I.

7660—July 24—Approving Canadian Northern Railway Standard Tariff of Berth and Seat Rates, C.R.C. No. S.I.

7661—July 24—Approving Michigan Central Railway Company Standard Tariff of Maximum Sleeping and Parlor Car Tolls, C.R.C. No. S.I.

7662—July 24—Approving the Wabash Railroad Company's Tariff of Parlor Car Fares, C.R.C. No. S. 2.

7663—July 24—Approving Toronto, Hamilton and Buffalo Railway Standard Tariff of Maximum Sleeping and Parlor Car Tolls, C.R.C. No. S.I.

7664—July 24—Approving Rutland Railroad Company Standard Tariff of Maximum Sleeping and Parlor Car Tolls, C.R.C. No. S.I.

7665—July 24—Approving the Esquimalt & Nanaimo Railway Company Tariff of Parlor Car Rates, C.R.C. No. S.I.

(Continued on Page 210.)

# A PAGE OF COSTS

## ACTUAL, ESTIMATED and CONTRACTED

### CONCRETE SEWER.*

The main sewer on Princess Street, Hamilton, Ont., from Sherman Avenue to Wentworth Street, is 24 inches diameter, and it was proposed to build this with fire clay pipe. All the other main sewers, being of larger diameter, were built of concrete. Before finally deciding on fire clay pipe in that section, 100 feet of 24-inch sewer was laid, composed of concrete, mixed 1:2:4, four inches thick, two-thirds of the sewer being constructed in the trench, the upper one-third was moulded on the surface and placed in the sewer after being properly set. The cost of this section of sewer was carefully kept in detail, with the result that the concrete sewer was found to be much cheaper than the fire clay pipe. Therefore, it was decided to construct a concrete sewer in this section.

**Cost of 24-inch Diameter Concrete Sewer—Labor and Materials—100 Lineal Feet.**

| | |
|---|---|
| **Labor.** | |
| Bottom, 2:3, 9 men 9 hours at 20c | $16 20 |
| Bottom, 2:3, setting moulds, 3 men 9 hours at 20c | 6 21 |
| Top, 1:3, moulding, 2 men 18 hours at 20c | 7 20 |
| Setting tops | 10 00 |
| **Material.** | |
| 70 bags cement | $35 00 |
| 5 loads gravel (10 cubic yards) | 10 80 |
| Coal for mixer | 1 00 |
| Total cost for 100 feet | $86 41 |

Cost per lineal foot of concrete pipe sewer 24-inch diameter, 86 4-10c.

### LOCAL COSTS OF PIPE-LAYING IN NEW ENGLAND.

In their recent investigation of the Boston Water Department, Metcalf & Eddy, consulting civil engineers for the Boston Finance Commission, collected considerable comparative information regarding the cost of pipe-laying in various cities in New England. These costs were all on the day labor basis by municipal forces. The difference in dimensions of the trenches and in wages and hours of labor made comparison somewhat difficult, but the engineers succeeded in reducing to practically a uniform basis, and in adjusting the rates at different periods so as to conform to the period covered by the cost determination in Boston. This includes 2½ years, namely 1905 to July 1st, 1907. From Metcalf & Eddy's report, which has recently appeared in a volume of some 1,200 pages the following digest has been made:

In the accompanying table are given, following the name of each city, the wages and hours of common labor during the period under discussion; the length of pipe included in making up the average cost; the years in which this pipe was laid; the actual labor cost per foot; the depth of trench; the corresponding cost per foot for a trench six feet deep, such as is used in the City of Boston; and, finally, the corresponding cost for a six-foot trench, if the wages had been uniformly $2 per day and the hours sixty per week.

In making the computations, it was assumed that a trench six feet deep would cost 20 per cent. more per foot than one five feet deep. As a matter of fact the actual increase in cost would probably be something less than 20 per cent., since there would be very little if any increased cost of placing the pipe, making joints, etc., and no increase in the cost of teaming. On the other hand, the cost of excavation for the lowest foot might be a little greater than one-fifth of the average cost, but in most cases probably not enough greater to offset the practically unchanged cost of the items mentioned above. The addition of 20 per cent. is, therefore, probably more than ample to allow for the increased depth of trench.

In reducing the actual costs to what they would have been had the wages been $2 per day and the hours sixty per week, it has been assumed that the actual efficiency of labor per hour was unaffected by the change in hours and wages.

The figures in the last column of the table should be absolutely comparable. The greater difficulties encountered in Boston on account of many obstructions, etc., do not enter, since all jobs involving such difficulties have been rigidly excluded from the computations and comparisons.

From them it is evident that the pipe-laying cost in the City of Boston is 69 per cent. greater than that of the average of the other seven cities, and nearly 44 per cent. greater than the cost in Worcester, where it is the highest of any of the seven.

In the case of Cambridge, besides data showing the cost in 1905, average labor cost per foot was furnished of laying 4, 6, 8 and 12-inch pipe from 1894 to 1903. The fluctuations in these costs are not remarkable, and there was no wide divergence from the average during this period of ten years. After adding 20 per cent. to make the figures comparable with those for six-foot trench in Boston, the average for the ten years was 40.4 cents per foot for all sizes, or, separating the figures, 31.4 cents for four-inch pipe, 35.1 cents for six-inch, 43.4 cents for eight-inch and 51.6 cents for twelve-inch. In 1905, however, as already noted, the average cost on the comparative basis was 60.3 cents per foot, an increase of 49 per cent. over the average for the ten years 1894-1903. No data were furnished which explained the sudden increase.

Reducing 40.4 cents per foot to the $2 per day and sixty hour per week basis, the comparative labor cost of pipe-laying in Cambridge prior to 1904 was found to be 31.6 cents per foot. During this same period, 1894-1903, the labor cost in Boston reduced to the same basis was rapidly increasing, and ranged from 37.3 cents at the beginning of the period to 59.3 cents at the end, or from 18 per cent. to 88 per cent. more than the cost in Cambridge.

Metcalf & Eddy show that from the foregoing information it can only be concluded that under labor conditions as they exist in other neighbouring cities, a fair average labor cost for pipe-laying work, reduced to the uniform basis of $2 per day and sixty hours per week, would be about 42 cents per foot, with 50 cents as a maximum. Of course individual pieces of work would often exceed the average and others would frequently fall considerably below it. As against these fair costs, this work cost the City of Boston, on the same basis of hours and wages, about 70 cents per foot for the three years prior to July 1907, or from 40 to 70 per cent. in excess of its reasonable cost.

Reduced to the basis of hours and wages, at the time of the report (i.e., forty-four hours per week and $2.25 per day), the fair average labour cost as estimated upon the basis of a cost in other cities would be 63.7 cents per foot, with 76.6 cents as a reasonable maximum, against which the average cost for the previous two and one-half years (on the same basis) was equivalent to $1.081 per foot, an excess of 44.2 cents per foot, or 69 per cent. over the fair average cost.

It is difficult to estimate the total excess cost resulting from this inefficiency of labor. The lengths of pipe laid from which the average costs were computed—including only those jobs on which there were no special difficulties which

*From information furnished by A. F. Macallum, C.E., City Engineer, Hamilton, Ont.

might render them not comparable with other jobs, and including no rock excavation—constitute but a small part of the total pipe of these sizes (6 inches to 12 inches) actually laid. It is probable that on the jobs involving special difficulties, where the actual labor costs must have been greater, the excess over a reasonable cost was also larger; and on contract jobs, which have usually been done at a less cost than the day labor jobs, the excess over a reasonable cost would be less. The total length of six-inch to twelve-inch pipe laid in the year 1906-07, as stated in the last annual report of the Boston Water Department, was 57,949 feet. If the excess labor cost on all of this may properly be taken as 44.2 cents per foot on the $2.25 per day basis, equivalent to 39.2 cents on the $2 per day basis, then the city actually paid $22,000 more than it should have done, for labor alone, in laying pipe of six-inch to twelve-inch diameter in 1907.

The total length of main pipes laid in the year 1906-07 was 71,307 feet. Since the inefficiency labor is not confined to work upon small sizes of pipe, and is experienced in some degree upon the contract work as well as upon that done by day labor, the engineers estimate that this inefficiency resulted in a total excess cost of pipe-laying, for labor alone, amounting to something like $20,000, and possibly much more, for the year ending January 31, 1907.

TABLE SHOWING COMPARATIVE LABOR COST OF LAYING PIPE IN VARIOUS CITIES.

| City. | Actual Average Wages—Hours of Common Labor. Wages. | Hours. | Length of Pipe Included in Computing Average Cost, Feet. | Year. 1905-06-07. | Actual Cost of Labor per Ft. of Pipe, Cents. | Depth of Trench, Feet. | Computed Cost of Labor per Foot of Pipe for 6-ft. Trench, Cents. | Corresponding Cost of Labor per Foot of Pipe with Wages $2, and Hours 60 per Week—Trench 6 Ft. Deep. Cents. |
|---|---|---|---|---|---|---|---|---|
| Boston | $2.00 | 44 | 12,151 | (To July 1). | 96.1 | 6 | 96.1 | 70.5 |
| Worcester* | 2.00 | 48 | 5,551 | 1907 | 50.9 | 5 | 61.1 | 48.9 |
| Cambridge | 2.00 | 47 | ..... | 1905 | 50.25 | 5 | 60.3 | 47.3 |
| Lowell | 2.00 | 48 | 5,915 | 1907 | 49.1 | 5 | 58.9 | 47.1 |
| Somerville | 2.00 | 47 | 2,418 | 1906 | 45.2 | 5 | 54.2 | 42.5 |
| Newton | 1.75 | 48 | 2,238 | 1906-07 | 53.0 | 6 | 53.0 | 42.4 |
| New Bedford | 2.00 | 48 | 15,720 | 1907 | 34.7 | 5 | 41.6 | 33.3 |
| Chelsea | 2.00 | 46 | 2,474 | 1906 | 32.7 | 5 | 39.3 | 30.1 |
| Average of all except Boston.. | 2.00 | | | | | | | 41.7 |

*It should be noted that a portion of the work done in Worcester in 1907 showed extremely high costs, and the average cost is therefore high. Had the year 1906 been taken the average cost in last column would have been 34.7c.

## RAILROAD ORDERS.

(Continued from Page 208.)

7666—July 24—Approving the Great Northern Railway Standard Tariff of Maximum Sleeping and Parlor Car Tolls, C.R.C. No. S.I.

7667—July 24—Approving G.T.R. tariff of Pullman Company's Berth and Seat Rates, C.R.C. S. 977.

7668—July 24—Approving G.T.R. Tariff of Parlor Car Tolls, C.R.C. No. E. 940.

7669—July 24—Approving Quebec Railway, Light and Power Company Parlor or Chair Tariff, C.R.C. No. S.I., between Quebec and St. Anne.

7670—July 24—Approving Central Vermont Railway Company Tariff of Pullman Company's Berth and Seat Rates, C.R.C. No. 233.

7671 — July 26—Authorizing the Vancouver and Lulu Island Railway Company to construct its railway across Granville Street, in municipality of Point Grey, B.C., such authority to be in force only for a period of three months from date of Order pending a further hearing by the Board in the City of Vancouver.

7672—July 23—Approving of plans for the superstructure of the bridge carrying the tracks of the Dominion Atlantic Railway Company across the Sissiboo River at Weymouth, N.S.

7673—July 29—Directing the Great Northern Railway Company to forthwith provide station accommodation at the old stopping places adjoining the spur constructed into the mill at Hazelmere, B.C.

7674—July 23—Extending until September 7, 1909, the time in which the G.T.R. and Bay of Quinte Railway Company shall establish and maintain a through joint rate on bituminous coal to Marlbank, Ont.

7675—August 3 — Authorizing the Canadian Northern Quebec Railway Company to construct a bridge to replace the wooden structure near Stonefield Station, Que.

7676—August 3—Authorizing the C.P.R. to open for the carriage of traffic that portion of the second track of the Ignac Section of its line of railway, from mileage 119.8 to mileage 120.0, a distance of 0.2 miles.

7677—July 30—Authorizing the C.P.R. to open for carriage of traffic the portion of its Ignac Section from mileage 115.1 to 120.8 Fort William Section, being portion of the double track.

7678—July 30—Authorizing the Bethesda and Stouffville Telephone Company to install its telephone instruments in the stations of the G.T.R. Company at Stouffville and Unionville, Ont.

7679—July 30—Approving plan of the New Brunswick Southern Railway Company for construction of a bridge at West Waweig, N.B.

7680—July 30—Approving detail plan of the subway at Winnipeg Street in the village of Schreiber, Ont., to be built by the C.P.R.

7681—July 30—Approving plans of the proposed bridge of the Canadian Northern Quebec Railway over Blanche River near Montcalm Station.

7682—August 3 — Authorizing the Canadian Northern Quebec Railway Company to construct its railway across public road between Lot 213 and Lot 147, Parish of St. Severin, mileage 71.44 west from the Quebec Bridge.

7683—July 16—Authorizing the Canadian Northern Quebec Railway Company to construct its railway across the public road between Lot 345 and Lot 344, 344-a, and 346 in the Parish of St. Prosper, at mileage 62.23 west from Quebec Bridge.

7684—July 16—Also across public road between Lot 336 and Lots 331, 332, 334, and 335, in the Parish of St. Prosper, mileage 61.0 west from the Quebec Bridge.

7685—July 16—Also across the public road between Lot 324 and Lots 317 and 318 in the Parish of St. Prosper at mileage 60.11.

7686—July 16—Also across public road between Lot 429 and Lots 430 and 432 in the Parish of St. Prosper.

7687—August 3—Authorizing the Canadian Northern Quebec Railway Company to construct its line across the public road on the north-east side of Lots 9 and 10 south-west of St. Severin Station, mileage 73.77 west from Quebec Bridge.

7688—August 3—Also across the public road on the north-east side of Lot 130 E., south-west of St. Severin Station, County of Champlain, Que., mileage 73.51 west from the Quebec Bridge.

7689—July 29—Authorizing the Canadian Northern Quebec Railway Company to open for the carriage of traffic the portions of its line from its connection with the Quebec and Lake St. John Railway at Quebec, to Garneau Junction, Quebec, a distance of 78.76 miles.

7690—August 3—Approving revised location of the Chemin de Fer de Colonization du Nord being about mileage 15 north-westerly to about mileage 20 north-westerly (from Nomining).

7691—July 16—Authorizing the Montreal Terminal Railway Company to construct, maintain and operate branch line on premises of the Lakefield Cement Company at Longue Point, Que.

7692—August 3—Authorizing the Bolton Telephone Company to carry its wires across the tracks of the C.P.R. at Lot 8, between Concessions 1 and 2, Township of Albion, Ont.

7693—August 4—Authorizing the Municipal Council of Maidstone, Ont., to carry wires across track of G.T.R. at Tecumseh Road, Puce Street.

7694—August 3—Authorizing the Oro Telephone Company to carry its wires across the tracks of the G.T.R. on Colbourne Street, in the Township of Oro, Ont.

7695—August 3—Authorizing the Fingal Telephone Company to carry its wires across the track of the Pere Marquette Railroad at public crossing three miles west of St. Thomas, in Southwold Township, Ont.

7696—August 3—Authorizing the Oro Telephone Company to carry its wires across the track of the G.T.R., where the same crosses the road allowance between Concessions 3 and 4 in the Township of Oro, Ont., north of the Ridge Road.

7697—August 3—Authorizing the Municipal Council of the Maidstone to carry its wires across the tracks of the C.P.R. at the road east of the Puce River public crossing, about three miles west of Bell River Station, Ont.

7698—August 3—Authorizing the C.P.R. to construct, maintain and operate spur to the premises of the Wood McNab Lumber Co., on the British Columbian Southern Railway, East Kootenay District, B.C.

7699—August 3—Authorizing the G.T.R. to construct five bridges between Chatham and Windsor, Ont., on the 18th District.

7700—August 3—Authorizing the Atlantic, Quebec and Western Railway Company to construct bridge at Grand River Crossing, Section 6, mileage 51.

7701—August 3—Authorizing the C.P.R. to construct branch line to premises of the Ontario Lime Association, on the north side of Dupont Street, Toronto.

7702—August 3—Authorizing the Canadian Northern Ontario Railway Company to construct bridge over the Vermillion River at mileage 26.66 from Sudbury Junction, Ont.

7703 — August 5—Temporarily approving pending the final determination by the Board of the tariffs of tolls which the Bell Telephone Company shall be authorized to charge, its agreements with six rural telephone companies.

7704—August 3—Authorizing the C.P.R. to construct bridge No. 77.7 on the Moose Jaw Section, Western Division.

7705—August 3—Authorizing the C.P.R. to construct bridge No. 9.4, North Branch Michael Creek, Cranbrook Section.

7706 — August 3—Authorizing the G.T.R. to construct branch line commencing at the G.T.R. station yard of the Town of Oakville, Ont., thence north-easterly and crossing the Seventh Line Road to the north side of the said road.

7707—August 5—Authorizing the Hamilton Cataract Power, Light & Traction Company to carry its power wires across the tracks of the Toronto, Hamilton & Buffalo Railway in the Township of Ancaster, at Horning Mountain Road.

7708—August 5—Recommending to the Governor-in-Council for sanction the by-law of the Canadian Northern Quebec Railway re spitting and smoking in cars and on premises.

7709—August 5—Recommending to the Governor-in-Council for sanction lease of the C.P.R. with the St. Mary's and Western Ontario Railway, dated February 1909.

7710—August 5—Recommending to the Governor-in-Council for sanction by-law of the Canadian Northern Ontario Railway re spitting and smoking in cars on premises.

7711—August 5—Approving location of the Canadian Northern Railway through Section 4, Township 22, Range 17, west of 6th Meridian to a point five miles beyond the Railway Belt, mileage 10 to 24.

7712—August 4—Approving location and detail plans of C.P.R. Station at Indian Head, Sask.

7713—August 5—Extending until October 1st, 1909, the time for the installation of gates at the crossings of the C.P.R. at Vancouver, B.C., at Columbia Avenue.

7714—July 15—Authorizing the Corporation of the City of Fort William to cross with the lines of its Electric Street Railway, together with the necessary poles and wires and to transmit power over the tracks of the C.P.R. at the intersection of the line with Pacific Avenue, Fort William, Ont.

7715—August 5—Directing the Commissioners of the Transcontinental Railway to provide an interlocking plant at the crossing of the Temiscouata Railway near Grand Falls, N.B., and authorizing the operation of trains at the crossing for construction purposes only pending the installation of the interlocking system.

7716—August 5—Approving book of reference of the United Gold Fields of British Columbia, Ltd., showing amended location of line from Frank to Grassy Mountain, B.C.

7717—August 5—Approving book of reference of the Esquimalt & Nanaimo Railway, showing change in location of line from mileage 100 to 107 and mileage 107 to 127.

7718—August 5—Approving location of the Georgian Bay and Seaboard Railway from mileage 48.05 to 63.42 from a point opposite Lot 17, Concession 1, in the Township of Eldon, on the County Boundary to point in Lot 23, Concession 12, Township of Mariposa, County of Victoria, Ont.

7719—August 5—Approving of revised location of Georgian Bay and Seaboard Railway from mileage 41.95 to 48.05, being from point in the north half of Lot 10, Concession 2, Township of Mara, to a point on the County Line east of south half of Lot 1, Concession 8, Township of Thorah, County of Ontario.

7720—July 28—Approving "exceptions" to the rating of silver ore to the official classifications as incorporated in the G.T.R. freight tariffs C.R.C. Nos. E-1599 and 1600 and C.P.R. freight tariffs, C.R.C. Nos. E-1422 and 1450, applying from North Bay, Ont., to certain points in the United States.

7721—August 3—Authorizing the Municipal Council of Maidstone, Ont., to carry wires across the tracks of the C.P.R. at public crossing about three miles west of Belle River Station.

7722—July 30—Authorizing the City of Brandon, Man., to carry water main under tracks of the C.P.R. and Great Northern Railway Companies on Twenty-Sixth Street.

7723—August 3—Authorizing the Bell Telephone Company to carry wires across the tracks of the C.P.R. and at public crossing, North St., Perth, Ont. 7724—At public crossing Wilson St., Perth Ont. 7725—At public highway crossing on the Cyrville Road, Ottawa, Ont., just east of the Rideau River.

7726—August 3—Authorizing the Bell Telephone to carry its wires across the tracks of the C.P.R about 800 feet east of Sturgeon Falls, Ont. (Nipissing Street).

7727—August 3—Authorizing the Bell Telephone Company to carry its wires across the tracks of the C.P.R. about 1,300 feet west of Mile Post 21 (on road allowance between the Townships of Springer and Pedley); 7728—across public highway crossing about 750 feet east of mileage 63 (west of Massey, Ont.).

7729—Authorizing the Bell Telephone Company to carry its wires across the tracks of the Central Vermont Railway Company at Lake Street, Waterloo, Que.

7730-3—Authorizing the Bell Telephone Company to carry its wires across the tracks of the C.P.R. 300 feet west of Sturgeon Falls, Ont. (King Street). 7731—At public crossing about 300 feet west of mileage 61 (west of Massey, Ont.).

7732—July 31—Authorizing the Caradoc and Ekfrid Telephone Company to carry its wires across the tracks of the C.P.R. on the town line between Caradoc and Ekfrid.

7733—August 5—Authorizing the Bell Telephone Company to carry its wires across the tracks of the C.P.R at Daniel Street, Arnprior, Ont.

## HYDRO-ELECTRIC DEVELOPMENT.

### Colorado Yule Marble Co.*

### By S. S. Stone, B.S.

In the northern part of Gunnison county, Colorado, its snow-capped peaks towering 13,000 feet above sea-level, stands White House Mountain. On its steep and oft-times precipitous slope are vast deposits of marble; literally a mountain of snow-white marble. Here are the quarries of the Colorado Yule Marble Co., 9,000 feet above the level of the sea.

Volumes might be written of the hardships endured and dangers incurred in opening these quaries; of the beauty and grandeur of the rugged scenery thereabouts. After leaving the hot springs of Glenwood, one of the beautiful little health resorts of Colorado, the train takes us through canons, along precipices, following the sparkling Crystal River, now on one side, now on the other, but always climbing, till, when we arrive at our destination, we discover that in the forty miles between Glenwood Springs and Marble, we have climbed nearly three thousand feet, and find ourselves at an altitude of eight thousand feet above sea level.

It is not our intention to extol the beauties of Colorado, nor to devote much space to the history and development of these quarries. It will be well, however, before going into the details of the electrical equipment and hydraulic development, to have a general idea of the quarries and mills, together with their present and future requirements of electrical power. I quote from an address given by the president of the company, Col. Channing F. Meek, at a meeting of the Denver Real Estate Exchange, Denver, April 15, 1908:—

"The existence of this great deposit of white marble in Gunnison county has been known for a great many years. About twelve years ago some of it was quarried by the use of dynamite, and placed in our State capitol. Probably you are not aware of it, but dynamite is about as congenial to marble as it is to glass. The result of that sort of quarrying was that this deposit, more important in my opinion and in the opinion of many who are competent to judge of it, than any deposit in this State, not excepting coal, so far as its value for this and the future time is concerned, was condemned.

"The matter was brought to my attention about four years ago. I read the reports, which seemed to be overdrawn and next to impossible of being true; but after a careful examination of the property I became firmly convinced that here was probably the greatest deposit of white marble in the world, and to-day my opinion of it is confirmed by what is, I believe, the most remarkable white marble quarry opening in the world.

"Of the value of this marble deposit to the State I do not believe a gentleman here has any conception. I doubt sometimes whether those who are concerned with it day by day can really appreciate it. We have over a billion and a half cubic feet of white marble, of which the sample before you may be taken as an average. This vast quantity of marble is so exposed that you can measure it with a rule just as you can measure the cubic contents of this room. We have opened the quarry, and have on the face of the cliff, which is so exposed for a mile in length, a quarry 240 feet long by about 40 feet in width. Because of the contour of the cliff, which permitted the effect of heat and cold through centuries to reach a few feet in from the surface, there was on the outside marble some slight evidences of this weathering. Now, we have gone in to a point where there is not a single sign of weathering. In one part of our quarry sixty-nine feet of the face is without a crack in any direction, and, had we the equipment with which to handle it, we could take out monoliths of marble as white and pure as that sample and as sound, sixty-nine feet long.

"Our present quarry equipment has a capacity to produce about 700 cubic feet of marble per day, and machinery is en route which will increase our production to 2,000 cubic feet per day by the end of this year. We have erected a finishing plant, which, for its size, is probably the most complete marble mill in the country, and, therefore, in the world, because American marble mills are the best known. By the first of August we shall have increased our finishing plant to a capacity of 750 feet per day, and we are prepared to increase it as rapidly as the need exists. This finishing mill is 674 feet in length by an average of sixty-five feet in width. The overhead travelling crane in front of the mill now in process of erection is 900 feet in length. We have installed a hydro-electric plant of 1,250 horse-power capacity. We have built a railroad from the terminus of the Crystal River Railroad above Red Stone to Marble. We have built machine shops, and have in process of erection a sawmill for lumber with which to box the finished marble. We have built roads, and we are building the town. We are preparing now to work our quarries day and night. It is fair to estimate that within five years from this time our capacity will reach 5,000 cubic feet per day of merchantable product."

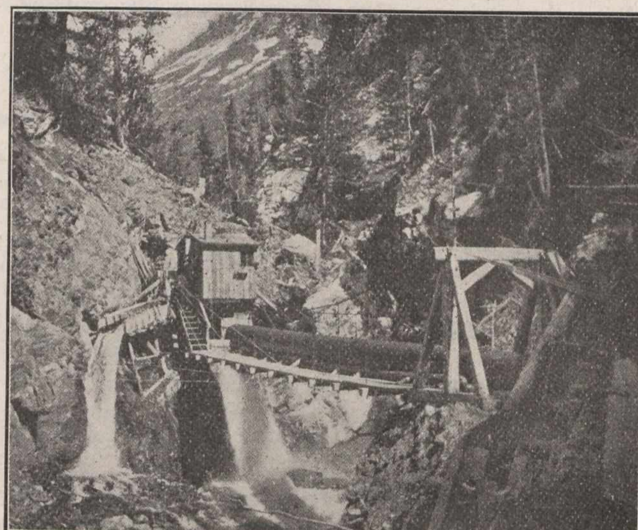


**Fig. 1—Pipe Line Construction, Hydro-Electric Development, Marble, Col.**

The first power plant, finished July, 1907, has been in operation since, and consists of a double DeRemer 5-foot water wheel belted to two 200-k.w., 2,300-volt, 60-cycle, three-phase alternating-current generators, running at 600 r.p.m., the speed of the water wheel being 278 r.p.m.

The water from which the power is derived is taken from the Crystal River and brought down in a steel pipe-line, 3,677 feet long, with a fall of 381 feet. Of necessity there are a number of bends, which reduce the effective head by about thirty feet. The pipe at the intake end is 36 inches in diameter, tapering to 26 inches at the power-house. There it is projected through two 3-inch nozzles on to the buckets of the water-wheel.

The site of the intake was selected where three huge boulders diverted the greater part of the water into a single narrow channel, thus reducing the size and expense of the necessary dam. A tunnel 119 feet long was driven through the solid rock, up to and underneath the bed of the river, and tapping it underneath the channel at the intake. At the lower end of this tunnel the pressure-box was located, and here the pipe-line begins. The Crystal River at this point flows in a series of steep falls through a narrow box-like canon, the walls of which are nearly perpendicular cliffs from 1,000 to 2,000 feet high.

The difficulties of laying such a pipe-line are at once apparent. To have driven a tunnel through the rock to the more level ground below would have required an enormous outlay of money and time. A shorter and much cheaper line

* From the Clarkson Bulletin, July, 1909.

was made by blasting a shelf out of the side of the cliff, and on this shelf the pipe-line now securely rests. To accomplish this men were let down by ropes or went down on wooden ladders, fastened to the top of the cliff. They there drilled and loaded holes in the face of the cliff, and were then drawn up out of danger while the blasts were fired.

At one place near the intake the line is carried across the canon on a bridge, supported by cables securely anchored to the cliffs. At another spot a tunnel had to be driven eighty-nine feet through a projecting cliff. It was a most difficult and hazardous undertaking, but fortunately the whole work was completed without a single fatality.

The shelves and tunnels were made large enough to contain two pipe-lines in addition to the one now installed, and the wisdom of this is already apparent, inasmuch as it is already necessary to lay a line to supply water for our second power-house.

The new plant, one unit of which is already installed and in operation, will contain two units, each consisting of a double DeRemer 4-foot water-wheel, with double nozzles, directly connected to a 450 k.w. 2,300-volt alternator.

The DeRemer water-wheels are made by the Dillon Iron Co., and differ from the Pelton wheel in that the buckets are ribbed laterally as well as radially. All of the electrical apparatus was manufactured by the General Electric Co., of Schenectady, N.Y.

Fig. 2—Traction Engine entering Mill Yard.

Each alternator will receive its exciting current from 11-k.w. direct-current generator, driven by its own water-wheel or motor, as the smaller sizes are called. Each exciter was placed on the shaft of its own generator in the old power-house. While this has its advantages in saving floor space and in economy of operation, it has this disadvantage: that a heavy load thrown on the generator momentarily retards the speed of both generator and exciter, and so furnishes a double cause for loss of voltage. The exciters, running at constant speed and provided with their own water-wheels, will insure much better regulation.

The switchboard panels are made of marble from our quarries. They are arranged in the usual manner, one panel for each generator, one exciter, and one distributing panel. The main bus-bars are common to both power-houses. The two plants will run in parallel, giving a capacity of 1,300 kilowatts. Each power-house is equipped with a ten-ton, hand-operated travelling crane to facilitate the handling of the heavy machinery.

Two transmission lines are run from the power-houses: one to the quarry, three miles away, and the other to the finishing mill, a distance of one and a quarter miles. The original line to the quarry consisted of three 75-k.w. oil-cooled transformers, located in a separate building, near the power-houses, which step up the voltage to 6,600 volts; three lines of No. 6 (B. & S.) gauge, bare copper wire, carried in double petticoat brown porcelain insulators, supported on wooden poles. In the transformer-house at the quarry the voltage is stepped down to 440 volts, which is the voltage for all the motors. The transmission loss of this line, including both sets of transformers, is 9 per cent. The capacity of the quarry line is now being doubled, each part with the exception of the poles, being duplicated.

In long distance transmission of power at a high voltage, line losses and sizes of conductors may be calculated to a nicety by the use of the tables of line constants published in electrical hand books or furnished by manufacturers of line wire; but for short distances and moderate voltages more simple methods are commonly used. In our case we have found the following simple formula to be of sufficient accuracy:—

$$A = \frac{D \times W}{P \times E^2} \times K$$

Where A = Area of conductor in circular mils.
D = Distance of transmission (one way) in feet.
W = Total watts delivered at receiving end.
P = Per cent. loss in line of W.
E = Voltage between main conductors at receiving end.

Values of the constant, K, for any particular power factor are obtained by dividing 2,160 by the square of that power factor for single phase, and by twice the square of that power factor for three-phase. The resistance of line wire is taken as 10.8 ohms per mil-foot. In our case, three-phase system and 85 per cent. power factor, K = 1,500.

The following data, together with what has been given above, although meagre, permits of comparison of the efficiency of the two plants.

**Colorado Yule Marble Co.—Hydro-Electric Installation.**

| Power House. | Old. | Old. | New. |
|---|---|---|---|
| Diameter of wheels (feet) | 5 | 5 | 4 |
| R.p.m. of wheels | 278 | 278 | 360 |
| Number of nozzles | 2 | 2 | 4 |
| Diameter of nozzles (inches) | 3 | 3.25 | 2.5 |
| Water pressure (lbs. per sq. in.) | 165 | 165 | 165 |
| Number of generators | 2 | 2 | 1 |
| R.p.m. of generators | 600 | 600 | 360 |
| Volts between phases | 2300 | 2300 | 2300 |
| Power factor (per cent.) | 85 | 85 | 85 |
| Amperes | 96 | 115 | 135 |

The load readings given are those of the greatest load which can be carried, at the rated speed, with the nozzles used and the gate valves wide open. The efficiency of the generators is guaranteed by the manufacturers to be 98 per cent. at full load and that of the water wheels to be 85 per cent.

The uneven and rocky nature of the mountains present difficulties for electric transmission as well as pipe-line laying which can hardly be appreciated by the eastern engineers. In placing the poles for the transmission line from the power-house to the quarry, for instance, fully forty per cent. of the holes had to be blasted out of solid rock.

The quarry equipment consists of one 200 h.p. induction motor, directly connected to a compressor, which supplies the air pressure for the pneumatic channelers, drills, and hoist; one 15 h.p. motor for pumping water; six electric channelers, and one 100 h.p. motor to run the hoisting apparatus.

The power is transmitted to the mill at generator voltage, the original line being of No. 4, bare copper wire. The new line is of No. 0000 copper cable. The poles used have a diameter at the top of ten inches.

At the mill the voltage is reduced to 440 volts and distributed at that pressure.

The old mill contains two 75 h.p. motors, which run the eight gang-saws employed in sawing the marble into slabs and blocks of the desired size; one 75 h.p. and one 50 h.p. motor furnish the motive power for the rubbing beds, polishers, planers, turning lathe, and hoisting machinery.

One 50 h.p. motor is installed in the machine shop across the railroad track from the mill, and another of the same size in the wood finishing shop a short distance away.

In the new mill will be ten 75 h.p. motors; five will keep in continuous operation the twenty-two gangs, and the remainder will operate the finishing machinery. In addition to the outside crane, mentioned by Col. Meek in the abstract referred to (which crane has a span of seventy feet), there will be an electric travelling crane inside the building for conveying the marble blocks from the saws to the finishing-room, and thence to the shipping department.

The road from the quarries to the mill, three and one-half miles in length, is one of the best mountain roads in the State. Formerly a mountain trail, it has been transformed, by months of labor, into a hard, solid road, twelve feet wide at its narrowest point.

At present the marble is being hauled by one 120 h.p. traction engine, drawing four wide-tired, heavy wagons, specially built for this purpose.

This train makes two trips daily, carrying from sixty to seventy-five tons of marble each trip. The wagons are loaded at the quarry by pneumatic hoist and unloaded at the mill by an electrically operated derrick.

This fall it is proposed to build an electric road over this route to transfer the marble from the quarries to the mill. A synchronous motor, direct-connected to a direct-current generator, will furnish the power. With a synchronous motor it is possible to "build up" the power factor of the line, which is necessarily low by reason of the many induction motors used throughout the system.

As the population of Marble increases, and it has doubled the last year, the lighting load becomes more a factor. There are in operation at the present time fifty arc lamps and 700 incandescents, with the number increasing daily.

The demand for power more than keeps pace with the power-house construction, so that as soon as a new generator is installed it is at once put in commission. For that reason no opportunity is given for making tests and little data are available.

## RELATIVE STRENGTH OF CONCRETE.

It is ordinarily assumed, at least by the inexperienced, that the strength of concrete is measured by the proportion of cement in a given mixture relatively to the amount of the other materials—sand and stone. But the fallacy of this assumption is shown by the fact that the total volume of concrete is always less than the sum of the volumes of its ingredients. This is due to the ability of the smaller particles—the cement in a semi-liquid condition and the fine sand—to fill all interstices or "voids" between the larger pieces of stone. More compact concrete can be secured by the use of gravel than broken stone—the angular pieces of the latter frequently arch together, allowing voids to form beneath. In a technical, yet very practical, way this subject is discussed in a recent paper by Mr. Leonard C. Wason, president of the Aberthaw Construction Company, Boston, Mass. He shows that for watertight work gravel is always to be preferred as compared with broken stone.

There is little difference in strength between concrete made by broken stone or by gravel. Mr. Wason has proved by actual test that broken stone having a rough surface with angular fractures will give an increase in strength over rough bank gravel of about 15 per cent. in most cases. In some, however, the gravel has given the greatest strength. This is always true if the stone has a glossy surface such as is found in some trap rocks.

In the first instance, if the specifications required one-three-six broken stone concrete, and there is a difference in cost between broken stone and gravel screenings of two cents per cubic foot, it will be cheaper to use a mixture of one-two and one-half-five with gravel and still obtain an equal strength with the broken stone. Mr. Wason makes the rule never to allow the size of stone in its greatest dimensions to be more than half the thickness of the work into which the concrete is to be placed. In large size work very much larger stone can be used than is ordinarily done with very good results, the only limitation being that of convenience in handling. In regard to placing, it is much easier to obtain dense concrete, that is, without voids, using gravel than using broken stone, as angular pieces will sometimes arch together, allowing a void to form underneath. Therefore, for watertight work gravel is to be preferred every time. For nearly all classes of work the best results will be obtained by using such an amount of water that the concrete when placed will just barely quake, but is not sufficiently soft to flow.

## EXPERIMENTS ON ELECTROLYSIS IN REINFORCED CONCRETE.*

**By A. S. Langsdorf.**

The possible corrosion of the steel reinforcement of concrete structure is a matter that must appeal strongly to engineers in view of the constantly increasing use of this

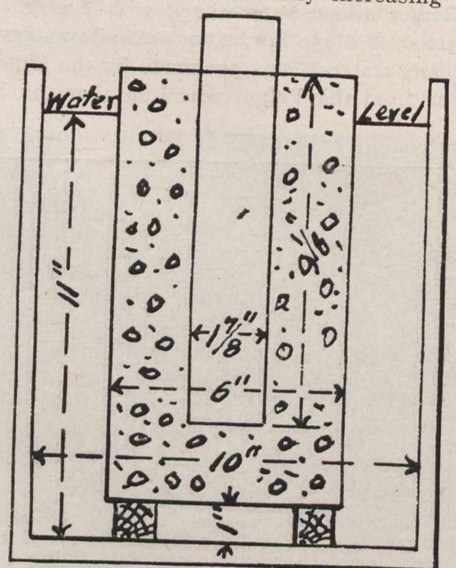



**Fig. 1. Arrangement of Specimen for Electrolysis.**

kind of construction. The subject in general has received considerable attention, but mainly along the lines of the effect of atmospheric action. Some experiments have been made to determine the electrolytic behavior of reinforced concrete, but thus far not on an extensive scale. Probably the most notable publised work in this direction is that of A. A. Knudson, New York, whose results are to be found in the "Proceedings of the American Institute of Electrical Engineers" of February, 1907; this appears to be the first account of an experimental investigation of the subject.

The experiments here described were carried out, under the direction of the writer, during the winter and spring of 1908, by M. M. Glauber, at that time a senior student of electrical engineering in Washington University. The work was undertaken as a graduation thesis, and was very carefully done; its general plan was an amplification of that adopted by Mr. Knudson.

The tests made by Mr. Knudson were two in number. In the first test, three specimens (Nos. 1, 2 and 3, respectively) were made by embedding 2-inch pipe to a depth of 8 inches in a mixture of equal parts of cement and sand; the kind of cement is not stated, but from the context it appears to have been a Portland cement. The mold was an ordinary metal pail, so that there was a thickness of between 3 and 4 inches of concrete all around the pipe. The bottom of the pipe was closed by a water-tight plug. The specimens were then placed in water, No. 2 in fresh and a constant current of 0.1 ampere was passed through them from a storage battery, the current entering through the pipe and leaving through the concrete. Specimen No. 1

*Read before the Engineers' Club of St. Louis and printed in the Journal of the Association of Engineering Socities.

had no current through it, in order to compare its condition with that of the other at the end of the test. The test was continued for a little over thirty days, current being on continuously. The results showed an unexpected deterioration of the concrete, and Nos. 1 and 3 in sea water. Specimens two and three were then connected in series and a steady current applied, large cracks appearing in it. There were also strong evidences of electrolytic action on the pipes, a layer of rust having formed upon them which extended into the concrete especially on the walls of the cracks; pitting of the pipes was very noticeable, and there was an appreciable loss of weight.

In the second set of tests two blocks (Nos. 4 and 5) were made, similar to the three others except that Rosendale cement was used. The test run was again continued for thirty days with the current constant at 0.1 ampere. The results were similar to those of the first test, except that No. 4 (in sea water) showed greater electrolytic action, a hole 1 x 3/8 inches having been eaten clear through the pipe. In the first test, No. 1, in sea water, but without current, was absolutely unaffected. A sledge hammer and chisel were required to break it open, and the pipe was clean and bright. In all the other specimens the concrete became soft and crumbly, so that in places a penknife could be easily thrust into it.

**Washington University Tests.**

The tests made at Washington University were also divided into two parts, but 12 specimens were used in each part. All of the specimens consisted of 1½ inch pipe embedded to depth of 9⅜ inches in a 1 : 3 : 5 concrete made rather wet and thoroughly tamped. The cement was Red Ring brand and the aggregate was crushed limestone. The thickness of concrete all around the pipe was 2 inches. The specimens, after ageing for about 50 days, were placed in six gallon glazed earthenware jars, raised above the bottom by wooden blocks, and were immersed in fresh water to within about 1 inch of the top of the concrete; fresh water was added as necessary to replace loss through evaporation. Fig. 1 shows the details of the specimens.

In the first run eleven of the specimens were then connected in series and a current of 0.05 ampere was passed

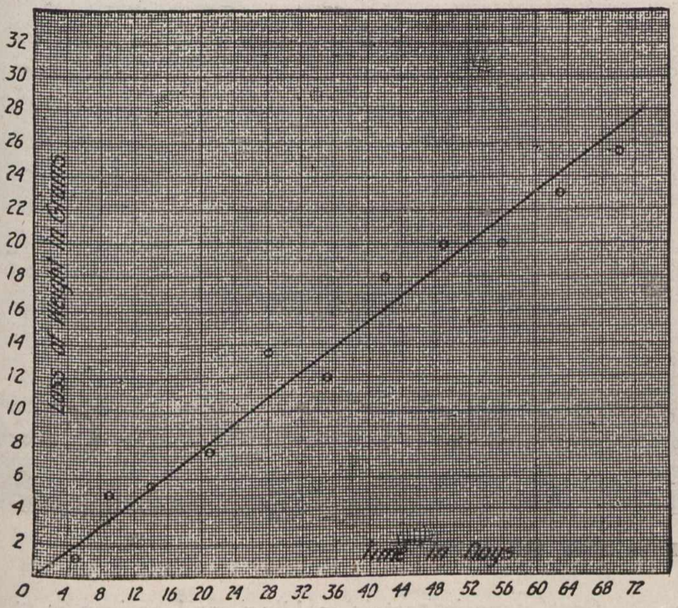



**Fig. 2. Loss of Weight of Concrete by Electrolysis in One Week.**

through them, the twelfth specimen being without current. The run was continued for 70 days continuously. (It will be noted that in this test the current was only half that used by Mr. Knudson, and the run was more than twice as long.) All of the pipes were weighed before embedding them in the concrete. At the end of each week one specimen was removed, broken open, and the pipe cleaned and reweighed, with the result shown in Fig. 2.

In the second run which continued for 33 days, the specimens were connected as before, but the current strength was raised to 0.2 ampere. The curve showing loss of weight in this case is drawn in Fig.3; during both runs, readings of the drop of voltage aroun dthe specimens were taken at regular intervals. The apparent resistence per specimen, calculated by dividing the volts per sample by the current, varied in the first run from 660 ohms at the start to about 1,200 ohms at the end; in the second test it changed from about 50 ohms at the start to about 500 ohms at the end. Mr. Knudson found an apparent maximum resistance of from 300 to 400 ohms per specimen, but differences in this respect are to be expected because of variations in the density, or porosity, of the samples. It is to be

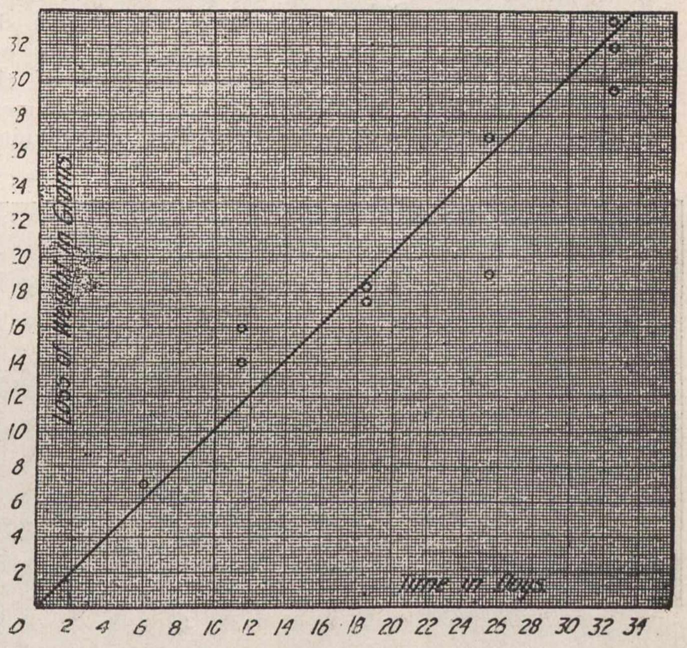



**Fig. 3. Loss in Weight of Concrete by Electrolysis in 33 Days.**

understood that these resistances are apparent only, for they include the effect of a very considerable polarization.

The specimens after their removal from the circuit show large radial cracks that formed in the concrete, and some show also a flaky white deposit that formed on the outside surface. Lack of time prevented making an analysis of this deposit, but this will be done in a further series of tests.

**Softening of the Concrete.**

The softening of the concrete observered by Mr. Knudson was confirmed in these tests, but it was not so marked as reported by him, probably on account of the different mixture used. The electrolytic action on the embedded metal was very strong, as shown by the curve of loss of weight. Whereas the specimens not subjected to the current remained clean and bright, the others developed a coating of rust whose thickness increased with the duration of current flow, and in all cases where cracks developed a coating of rust was deposited on the walls of the cracks.

The cracking of the concrete may possibly be explained by the fact that the layer of rust is of rather loose consistency, so that its density is less, and its volume greater than that of the original material, thus giving rise to a bursted force. The fact that the cracks are mainly radial seems to support this hypothesis.

Mr. Knudson's result, as well as those here described, indicates quite clearly that great caution must be used in the construction of reinforced concrete structures where the conditions are similar to those of the tests such, for example, as might be found in the case of bridge abutments or concrete sewers in the neighborhood of grounded railway circuits. Further information is needed as to the extent to which the reinforcement of such structures, when buried in damp or wet earth, may become part of the return circuit of trolley lines; and also to determine the insulating effect of waterproofing ingredients in the concrete. It is the intention of the writer to take up these subjects in a further investigation, and it is hoped that others will also undertake the study of this important subject.

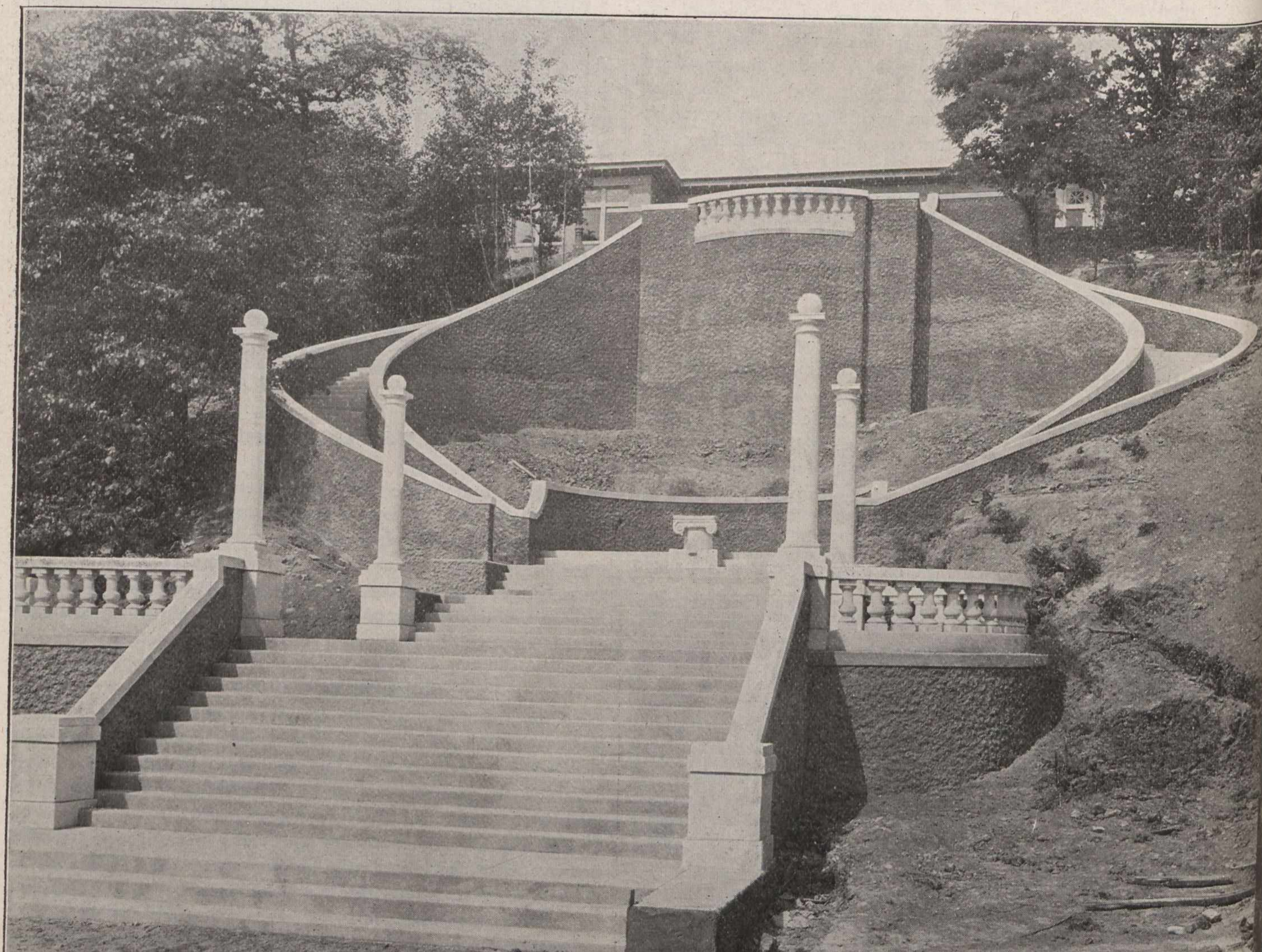
## PARK ORNAMENTATION.

**Extensive Work Carried Out at Lake Park, Milwaukee—Effect of Highy Expensive Stone Shaping Produced in this Material.**

An extensive piece of cast stone work is to be seen at Lake Park, Milwaukee. Lake Park overlooks Lake Michigan from a bluff, cut here and there by ravines. The park board built a carriage drive connecting the bluff with the beach, and wished to make a stairway down which those frequenting the park on foot might reach the water easily. At the same time, it was desired to give access to an athletic field being laid out on a natural amphitheatre just above the level of the lake and, moreover, to add an architectural ornament to the park suggestive of Grecian simplicity and dignity.

which the terrace terminates are each surmounted with a tall flag pole. The cast stone in this work consists of the Ionic sun dial, a number of Doric columns, some thirty-two pedestals, four hundred feet of balustrade, and two bases for the flag poles each weighing three tons.

The manufacturers of this cast stone work, Messrs. Hutchens & Friske, Milwaukee, were successful in producing balusters and columns with a smooth fine surface and a crystalline whiteness. The fine crystals in the stone add to its attractiveness particularly in the sunlight. The cement steps and concrete walls rough casted with cement were built by the Austin Construction Co. The whole scheme was designed and superintended by Mr. A. C. Clas, of the Milwaukee park board, his work being entirely gratuitous. The cost of the cast stone work was $5,000, and of the entire work $16,000.



**Cast Stone Work in Lake Park, Milwaukee.**

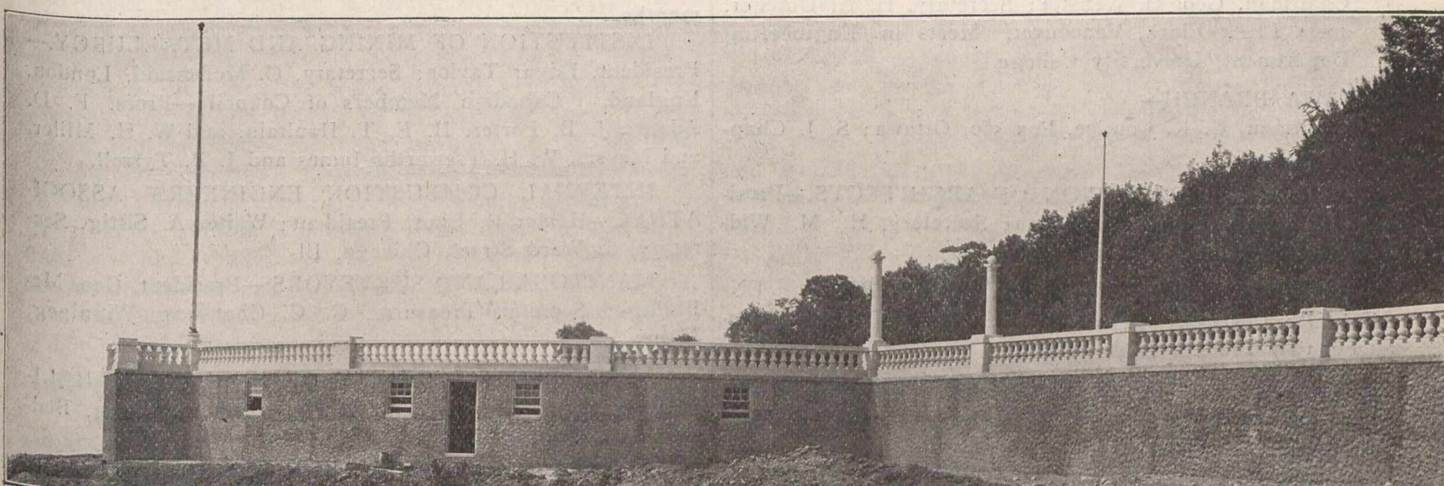
White stone would form the finest contrast with the green of the bank and the blue of the lake, and white was desired but the expense of stone or marble work was so great that cast stone, a process of manufacture rapidly coming into general notice, was decided upon. The results have been very satisfactory to the board.

Starting at a small paved "lookout" in the rear of the park pavilion on top of the bluff, as illustrated, winding stairs descend to a recess containing a sundial. From thence there is a further descent between Doric columns to the lake. Midway in this incline a terrace leads off to the south to the athletic field and to a graceful series of curving seats and steps. The forks into

Cast stone is cast in molding sand as iron is cast. It is a patented process. The molding sand used in this case is a white silica sand brought from Illinois, moistened with water and tamped hard around the wooden pattern which has been made of the baluster or column or other ornament desired. After the pattern has been removed, the liquid concrete is poured through a hole in the top and allowed to stand for twenty-four hours. The baluster, for an example, is then taken from the form and allowed to stand five or six days before the sand still adhering to it is brushed off. It is found that the sand of the mold has absorbed the water from the liquid concrete and left it hard and possessing a smooth, fine finish. The finished product should be left to cure for sixty days protected from the sun and weather before it is exposed to those elements. This curing seasons it and, with care exercised elsewhere and with proper materials, is likely to prevent any danger of hair cracking.

The composition of the stone cast at Lake Park was lime-stone dust, Chicago AA Portland cement and water with water-proofing and densifier added. Marble dust is often used. The limestone dust used in this instance was brought from Missouri where it is produced from a fine quality of white rock found there. Freight and grinding render it expensive. The cement should be thoroughly aged to weather out any free lime contained in it. Lime may be found in green cement and if such cement is used in cast stone work the lime is apt to be blown by sun and water and to produce hair cracks. The cement should also be as white as possible.

With care taken in the purchase of materials, in conducting the work and in ageing, cast stone may be produced that is very pleasing. Its cheapness as compared with stone is made possible particularly when a large number of pieces are molded from the same mold such as balusters and other parts of this work in Lake Park. Its cheapness will often make possible work of this kind that would otherwise have to be abandoned. That is, the effect of elaborate and highly expensive stone shaping and stone carving duplicating classic architectural models may be and undoubtedly will be produced in cast stone at a cost within the reach of the average builder. Cast stone will be particularly serviceable in large work like the work just described, in viaduct and bridge railings, etc., where the general effect desired would be too expensive if stone were to be used. Cast stone is whiter than Bedford stone and in many cases this will be found to give an effect not possible to secure without the use of marble.



**Cast Stone Work in Lake Park, Milwaukee —Termination of the Terrace.**

## THE REAL VALUE OF STEAM COAL.

**D. T. Randall.***

In general it may be said that a furnace may be designed to burn almost any kind of coal with good efficiency, and that the real value of a coal depends very largely upon the number of British thermal units which it contains. Tests which have been made at the Government Fuel Testing Plant seem to indicate that the most important thing to be considered in a coal is its heating value. Following this, the size of the coal may be considered as next in importance, and when the moisture, volatile matter and ash are widely different they must also be considered. The results of more than 400 boiler tests at the Government Testing Plant show that the average drop in efficiency for a range of coals between 14,000 B.t.u. and 10,000 B.t.u. is only about 6 per cent. This difference is due to the combined influence of the size of the coal and the moisture, the volatile matter and ash in the coal. It will be seen from these figures that the probable influence of any of these constituents is not as great for hand-fired furnaces as it is often thought to be. With certain boiler equipments in which a considerable overload is necessary at times, the effects of these constituents may be obtained, and it is for this reason that when coal is selected for a given plant it is important that the coal supplied should not vary greatly from time to time. Otherwise the fireman may have serious difficulty in maintaining the capacity required, and in burning the coal with good efficiency.

With a furance which is well designed, there should be a close correspondence between the heating value of the coal and the water evaporated. Small variations in moisture, volatile matter and ash should make little if any difference in the efficiencies obtained.

* Engineer in charge of the Fuel Engineering Department of the Arthur D. Little Laboratories, Boston, Mass.

The size of the coal may influence the results to a serious extent. Small sizes of anthracite coal packed together closely, and strong draughts are required to burn them. This results in holes in the fire and a leakage of air in the boiler settings. The loss is often estimated to be at least 10 per cent. This is also true of many of the bituminous coals. Other coals which coke readily, forming a loose bed of fuel, do not show much loss, due to the presence of fine coal, except such as is so small as to be carried off from the grate by the draught. With any character of coal there may be a loss of fine coal, due to sifting through the grates. That this loss may be large is well known. The carbon in the ash is an important item in determining the losses in a boiler room. In many plants care on the part of the fireman has reduced this loss to the equivalent of 2 and 3 per cent. of the fuel fired. Occasionally owners of power plants have purchased for testing purposes a coal of higher grade than they usually furnish for the boiler furnaces. The results obtained have often been disappointing, and without further investigation they have declared that the plan of purchasing coal on the basis of its heating value is at fault and that corresponding results cannot be obtained from the higher grade coals. On the other hand it has happened that others have tried coals of lower heating value than the coal regularly burned in their plant, and they often find a greater drop in the evaporation than they expected. This has led many people to believe that there is a great difference in the value of coals for only slight variations in the composition.

Boiler tests are a rather crude method of comparing coals, especially if the fireman is not accustomed to burning the coal to be tested.

A chemical laboratory test is conducted under conditions which may readily be duplicated, and the results are therefore more reliable than boiler tests.

## ENGINEERING SOCIETIES.

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

QUEBEC BRANCH—

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

TORONTO BRANCH—

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

MANITOBA BRANCH—

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

VANCOUVER BRANCH—

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

OTTAWA BRANCH—

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

## COMING MEETINGS.

**Canadian Forestry Association.**—At Regina, Sask., September 3rd and 4th. Special meeting. James Lawlor, 11 Queen's Park, Toronto, Ont.

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

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

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

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

**National Gas and Gasoline Engine Trades Association.** Harry T. Wilson, treasurer, Middleton, Ohio; Albert Stritmatter, Cincinnati, Ohio. Next meeting November 30, December 1, 2, 1909, at Chicago, Ill.

# CONSTRUCTION NEWS SECTION

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

## TENDERS.

**Quebec.**

MONTREAL.—Tenders will be received up to noon on Tuesday, 14th September for the enlargement of the city's aqueduct, by widening and deepening the same on a length of about 27,300 feet. The work comprises about 1,176,000 cubic yards of earth excavation and about 400,000 cubic yards of rock excavation, also the formation of the slopes and banks of the widened aqueduct, the transporting to a distance of excess of excavated material, the construction of syphon culverts, the construction of dry stone wall lining in the slopes, etc., etc., the whole according to plans, cross-sections and specifications, to be obtained from George Janin, superintendent and chief engineer of the Montreal Waterworks, City Hall. (Advertised in Canadian Engineer.)

MONTREAL.—Tenders for electric light wiring and fittings for the addition to Montreal Post Office will be received until 5 p.m., Wednesday, August 25. Plans and specifications to be seen on application to A. Venne, architect, Montreal, and Napoleon Tessier, secretary, Department of Public Works, Ottawa.

**Ontario.**

GODERICH.—Tenders will be received up to noon of August 31st, for the erection of a nine-roomed public school, in the town of Goderich. Plans and specifications may be seen at the office of A. J. Barclay, architect, Crown Life Building, Toronto, or A. D. McLean's clothing store, The Square, Goderich.

TORONTO.—Tenders will be received up to 12 o'clock noon on Monday, August 23rd, for Bridges and Culverts on the wagon road from the Montreal River at Smyth to Gowganda as follows: One bridge at Lost Lake, 290 feet long, with approaches. Two bridges at Long Point Lake, 25 feet long, with approaches. Four bridges between Lost and Leroy Lakes, 25 feet long, with approaches. Two bridges at Miller Creek, 25 feet long, with approaches. About 400 feet of side hill bridging near Lost Lake. And about 45 culverts. The work is to be completed by the first of October, 1909. Plans and specifications and tender forms may be seen at the office of C. H. Fullerton, Engineer, New Liskeard, or F. Cochrane, Acting Minister of Public Works.

TORONTO.—Tenders will be received until Thursday, October 14, for turbine pumps. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Thursday, October 14, for electric motors. Further particulars may be had from the city engineer. (Advertised in the Canadian Engineer.)

AMULREE.—Tenders will be received up to Friday, August 27, for the $3,695.40 debentures for drainage works. J. D. Fisher, Township Clerk, Amulree P.O., Ont.

PARKHILL.—Tenders for electric light fixtures, etc., will be received until Monday, August 23. Plans, etc., to be seen on application to James Phelan, Clerk of Works, Parkhill; T. A. Hastings, Clerk of Works, Customs Building, Toronto. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

TORONTO.—A number of timber and tie berths in the districts of Algoma, Sudbury, Thunder Bay, Kenora, and Rainy River, Ont., will be offered for sale by public tender on Wednesday, September 15th. For plans, etc., apply to F. Cochrane, Minister, Department of Lands, Forests and Mines.

ORILLIA.—Tenders will be received until 8 p.m. Thursday, September 9, for constructing the following works: Contract "A," Sanitary Sewers, about 15,000 lineal feet. Contract "B," Sewage Pumping Station. Contract "G," Sewage Pumping Machinery. Contract "O," Force Main, about 7,000 feet iron pipe. W. C. Goffatt, Mayor, Orillia. Willis Chipman, C.E., chief engineer, Toronto, Ont.

TORONTO.—Tenders will be received until Monday, October 4th, for erecting the Wilton Avenue Bridge. Joseph Oliver (Mayor), Chairman Board of Control. (Advertised in the Canadian Engineer.)

LOCHIEL.—Tenders will be received until Wednesday, August 25th, for the construction of a drain. Total length of excavation 19,700 feet; total estimated excavation 11,300 cubic yards, of which 206 cubic yards are hard pan. Plans and specifications may be seen at the office of Magwood & Walker, civil engineers, Cornwall, On.; V. G. Chisholm, clerk.

GUELPH.—Tenders will be received until Tuesday, August 24th, for the construction of three concrete bridges. L. Malcolm, city engineer. (Advertised in the Canadian Engineer.)

**Manitoba.**

WINNIPEG. — Tenders will be received by Winnipeg Public School Board up to Monday, August 30th, for a heating and ventilating plant to be installed in the Greenway School. For plans, etc., apply to J. B. Mitchell, Commissioner of School Buildings, School Board Office; R. H. Smith, secretary-treasurer.

**British Columbia.**

VANCOUVER.—Tenders will be received up to Monday, September 6th, for grading and bridging of the Alberni branch of the Esquimalt and Nanaimo Railway Company from the 108th mile to Alberni (27½ miles). See Mr. Bainbridge, Division Engineer E. & N. Railway, Victoria; Mr. H. J. Cambie, Chief Engineer, E. & N. Railway, Vancouver, for plans, etc. R. Marpole, vice-president.

VICTORIA.—Tenders are invited until September 15 for the supply of about nine hundred tons of cast iron socket pipes and special castings. T. Lubbe, secretary, Esquimalt Waterworks Company.

VICTORIA.—Tenders will be received up to Saturday the 28th August for constructing and completing sections 2, 3, 4 and 5, in all ten miles in length, more or less, of the Vancouver Island Trunk Road. Plan, profile, drawings, specifications and forms of contract and tender may be seen. F. C. Gamble, Public Works Engineer, Department of Public Works.

VICTORIA.—Tenders will be received up to Saturday the 21st August for the cables and metal required in connection with a suspension bridge over the Fraser River, to be delivered at Lytton, B.C., on or before the 30th October, 1909. Drawings, specifications, contract and forms of tender may be seen at the office of R. J. Skinner, timber inspector, Vancouver, and at the office of the Government agent, New Westminster. F. C. Gamble, Public Works Engineer, Public Works Department, Victoria.

## CONTRACTS AWARDED.

**Quebec.**

SHERBROOKE.—Mr. C. Beauchesne, manager of the Sherbrooke Construction Company, has secured a contract for new buildings to be erected in Sherbrooke by the C.P.R. These include a station, engine house, coal chutes, and a machine shop. The contract price is in the neighbourhood of $40,000.

**Ontario.**

TORONTO.—Contracts have been let for the construction of the first Government wagon roads north of the Height of Land, by the Provincial Department of Public Works. From Matheson on the Temiskaming and Northern Ontario Railway, seven miles of highway will run eastward, while from Cochrane, the terminus of the Ontario Government Railway, nine miles will be built in a northerly direction. The contractor is Mr. D. H. Black, of Parham, Addington.

TORONTO.—Contracts for the remaining transformer stations in connection with the building of the Government power transmission line were awarded by the Hydro-Electric Commission on August 11th. The only remaining contracts to be let in connection with the whole construction of the line are for the portion of the mechanical equipment comprising cranes, heating and water-piping. The contracts for the erection of the stations at St. Mary's, Stratford, Berlin and Guelph, were awarded to Messrs. Edge & Gutteridge, of Seaforth, at $18,700 each, while those at Preston, Paris, Woodstock, and St. Thomas, went to John Hayman, of London, at $19,850 each. The contract for the supplying of 12,000 galvanized clamps to carry the cable was given to Messrs. Pratt & Latchford, of Brantford, the lowest tenderers. The total price will be about $6,000.

NIAGARA FALLS.—A meeting was held on Saturday evening to consider tenders for the construction of walks, gutters, and face walls for the Kitchener Street and Glenview public schools. The tender of J. S. McCracken, which was 11½ cents per foot and $611.60 for the whole work, was accepted. Work will begin on the improvements at once.

ST. THOMAS.—A. Sells, of Port Burwell, was given the contract for building a new road on Kane's Hill, at $3,000. The contract was let by auction, City Engineer Bell acting as auctioneer.

TORONTO.—The Provincial Government has awarded contracts for the construction of seven miles of roadway east from Matheson and nine miles north from Cochrane to D. H. Black, Parham, Addington County, who submitted the lowest tender. The proposed work signalizes the advent of the first Government wagon roads north of the height of land. It is proposed to further extend the roadway work in opening up the district.

TORONTO.—Contracts were awarded by the Provincial Public Works Department to Edward Gearing, of Toronto, for enlarging the boiler house at the Normal School for $2,345 and for painting Osgoode Hall to R. J. Hovenden for $2,200.

GUELPH.—The Light and Power Commission for the corporation of the City of Guelph have awarded a contract to Messrs. Vandeleur & Nichols for the supply of two large frequency changer sets and switchboards, and for the supply of motors, manufactured by the Lancashire Dynamo and Motor Company, aggregating about 1,600 horse-power.

**Saskatchewan.**

SASKATOON.—Tenders for the new Collegiate Institute were opened recently, and the contract awarded to the lowest bidder. The following quotations were submitted: Brandon Construction Company, $93,669; Garson Harnes Company, $92,945; S. Brown, Winnipeg, $92,870; Mooers & Wells, $91,650; Neil Stuart, $89,497; Smith Bros. & Wilson, $87,500, and the Saskatchewan Building and Construction Company, of Regina, $84,555. The contract was therefore awared to the last mentioned firm, their contract price being $9,114 lower than the highest bidder.

MOOSE JAW.—The City Council have let contracts as follows: Concrete bridge, the Parsons Construction and Engineering Company, at $7,490; the plank walk, George Fitchett, 29c. per lineal foot; concrete walks, Navin Bros.

REGINA.—The following contracts have been closed by this city: Canadian Westinghouse Company, Ltd., one 500 K.V.A. low pressure turbine generator unit with switchboard panels and instrument, at a cost of $15,000 f.o.b. Regina. Canadian Westinghouse Company, Ltd., one exciter unit, consisting of Westinghouse horizontal turbine, direct connected to Westinghouse direct current Turbo generator to cost $1,768. C. H. Wheeler Manufacturing Company, one C. H. Wheeler improved surface condenser, $4,500.

**Alberta.**

LETHBRIDGE.—The City Council acting on the advice of Smith, Kerry & Chace, their consulting engineers, and the local engineers, Messrs. Arnold & Reid, gave the contract for the coal and ash conveyers for the new power plant to Babcock & Wilcox, of Montreal, for $7,775.

EDMONTON.—Charles May of this city has been awarded the contract for the construction of the sub-structure on the Macleod River and Wolf Creek bridges, the cost of which will be in the vicinity of a quarter of a million dollars.

**British Columbia.**

VANCOUVER.—The fire committee is considering the following tenders for a new patrol auto:

| | |
|---|---|
| F. Darling & Co., 50-60 h.p. | $6250 |
| E. P. Browning, 52-90 h.p. | 5600 |
| E. P. Browning, 45-35 h.p. | 5300 |
| E. P. Browning | 5000 |
| Storey & Campbell, 40 h.p. | 4950 |
| W. J. Massey & Co | 4500 |
| C. W. Sancliffe & Co., 40 h.p. | 5300 |

FERNIE.—A. J. Watson will build the new fire hall for $12,160. The contract was originally given to Al. Rizztuo, at $10,420. Mr. Rizztuo afterwards asked to increase his figure to $11,820, but it was thought inadvisable by the council to create the precedent of allowing tenderers to change their figures.

**Foreign.**

PORTLAND (ME.).—The Aberthaw Construction Company, Boston, Mass., have recently taken contract for adding three storeys to the Crocker warehouse on Cumberland Avenue, owned by the Portland Savings Bank, E. F. & F. H. Fassett, architects. The existing building is a five-storey reinforced concrete structure, which the Aberthaw Company erected several years ago. The columns will be reinforced to carry the extra weight of the additional floors, and the building completed to correspond with its existing design.

## RAILWAYS—STEAM AND ELECTRIC.

**Quebec.**

MONTREAL.—Grading on the C.P.R. double track between Vaudreville and Finch will be completed next week, and the track laying will be executed in the fall. J. P. Mullarkey, contractor for this work, which represents fifty-five miles of construction, says the whole of the building operations will be executed in time to give the C.P.R. a double track all the way from here to Smith's Falls before the end of the year. This is to be an essential part of the company's grain line from Victoria Harbor on Georgian Bay to Montreal, by way of Peterborough.

**Ontario.**

NORTH COBALT.—The grading for the electric railway from Cobalt to Haileybury is almost completed. The only delay now is that the Haileybury end where in deference to the representations of many citizens, the proposed line has been slightly altered. The change will not hamper the work, which will now be pushed with renewed effort.

OTTAWA.—Notice is given of the intention to apply to Parliament for a charter for the Rainy River Radial Railway Company, with power to build from the international boundary to Fort Francis to the Lake of the Woods at the mouth of Big Grassie River, with branches to Long Sault Rapids and with power for telephone, express, light, heat and power business.

**Manitoba.**

WINNIPEG.—The last party of Hudson Bay engineers, in charge of W. J. Clifford, arrived back from the north last Friday. They located the route from Split Lake to Fort

Churchill, and encountered no difficulties in all the two hundred miles. Since April they have been busy taking soundings in Churchill harbor. They have also inspected Nelson, and report that excellent harborage can be secured at either point.

WINNIPEG.—S. C. Hill & Son, who for the past three years have been engaged in bridge construction for the National Transcontinental east of the city, are moving part of their plant to Alberta this week, where they will be engaged in similar work for the Grand Trunk Pacific and the Calgary branch. Mr. Hill has secured the contract for the erection of the bridges on the first fifty miles of this branch. The outfit will be taken to Tofield on the G.T.P., from which point the teams will be driven in to the point where the first bridges are to be built. Of these latter there are two large structures, one over the Battle River, three thousand feet long and one hundred and fifteen feet high, and one smaller bridge eight hundred feet long. Mr. Hill has still to build the bridge over the Seine River east of the city and to complete one or two smaller structures, but with this exception all the work on his contract on the National Transcontinental is done. The bridge over the Seine will be built as soon as the course of the railway into the city through St. Boniface is determined.

WINNIPEG.—The announcement was made from the offices of the Grand Trunk Pacific recently that Smith Bros. & Wilson, of Regina, have been awarded the contract for the erection of over forty station houses along the main line between Winnipeg and Edmonton. All of these stations will be of a modern and artistic type, and the majority will cost in the vicinity of $5,000, while several will run as high as $10,000. Some of the points where these will be erected are Scott, Earl, Lazare, Kelliher, Punnichy, Seamans, Allan, Meighen, Ingloe, Justice, Hope, Uno, and Asquith. The Grand Trunk Pacific is spending a very large amount of money in whipping the western line into first-class shape, and the money spent on new buildings will figure into the hundreds of thousands.

WINNIPEG.—E. J. Chamberlin, vice-president and general manager of the Grand Trunk Pacific, has under consideration the bids for the construction of a most important section of that road. The contract calls for the completion of the dump through a somewhat rough country, extending from the Copper River, which is the east end of the present contract, east to Aldermere, a distance of 130 miles. In this division it is estimated that there are 1,500,000 cubic yards of rock to be removed. At a somewhat high estimate, it is computed that it will cost from $2 to $3 a yard to move this rock, which would mean an expenditure of from $3,000,000 to $4,500,000. The entire cost of the construction of the dump for the distance is estimated at from $5,000,000 to $6,000,000. For the first one hundred miles of construction from Prince Rupert east, the Grand Trunk Pacific will have to pay about $8,000,000. This contract is now being completed by the firm of Foley, Welch & Stewart, who expect to get through with their work in October. The expenditure of $8,000,000 on this hundred miles is explained by the fact that a great deal of work is being done at Prince Rupert, and that the work of the hundred miles is chiefly in a rocky country. The contract which is now being considered is for work through a country presenting fewer engineering problems and with less rock work.

**British Columbia.**

VANCOUVER.—Macdonell, Gzowski & Company, who had the contract for constructing the spiral tunnels in the Rockies, by which the "Big Hill" grade on the C.P.R. main line will be greatly reduced, was in the city recently closing up accounts in connection with the work. The whole of the contract, which is the biggest piece of tunnelling ever carried out in Canada, was completed and handed over to the company some days ago.

VANCOUVER.—Owing to the big increase in the traffic on the lines of the British Columbia Electric Company, and with a view to future developments on the new lines, whose construction is nearing completion, a new appointment has been made by the company of an assistant to F. R. Glover, the assistant manager, to have special charge of the Chilliwack line. S. L. Prenter, who for twenty-four hours has been associated with the C.P.R., has been given the appointment. Mr. Prenter is one of the best known railway men in Vancouver.

## CEMENT—CONCRETE.

**Quebec.**

SHERBROOKE.—Considerable cement will be used in the construction of new buildings to be erected at this point by the C.P.R. The Sherbrooke Construction Company have the contract.

**Ontario.**

GUELPH.—As will be seen by our advertising pages, Mr. L. Malcolm, city engineer, invites tenders for the construction of three concrete bridges, approximating 700 cubic yards of concrete.

NIAGARA FALLS.—J. S. McCracken has secured a contract from the School Board for concrete walks at 11½c. a foot.

**Saskatchewan.**

MOOSE JAW.—A contract for a concrete bridge to cost $7,490 has been given to the Parsons Construction & Engineering Company, and one for walks to cost $13,495 has been awarded to Navin Bros.

**Foreign.**

NEW YORK.—In the construction of the foundations for the railroad terminal that is being built by S. Pearson & Son, Ltd., at Vera Cruz, Mexico, approximately 3,000 Raymond concrete piles will be employed.

## LIGHT, HEAT, AND POWER.

**Ontario.**

TORONTO.—The hydro-electric terminal station in Toronto is to be located on Garrison Common, at the foot of Strachan Avenue, if the Board of Control's suggestion is adopted. The station will be 400 feet long and 200 feet deep.

**Quebec.**

MONTREAL.—After October 1st the Montreal Light, Heat and Power Company will allow a discount of 33⅓ per cent. on five-year contracts. The present rate is 15 per cent.

## SEWERAGE AND WATERWORKS.

**Quebec.**

MONTREAL.—Mr. George Janin, superintendent of the Montreal Waterworks, invites tenders until September 14th for waterworks extensions.

**Ontario.**

NORTH TORONTO.—In future the work of sinking water mains will be let by contract in this municipality.

**British Columbia.**

VANCOUVER.—The demand of the city for sewer pipe this year has been so great that the plant from which the supply is usually obtained has been totally unable to keep up with the demand. Thirty carloads have been brought in from Seattle and St. Louis and other shipments have been ordered. In addition, 10,000 feet of 10-inch pipe has been ordered from the Old Country.

## FINANCING PUBLIC WORKS.

The following municipalities have sold debentures:—Blandford Township, Ont., $4,022.70; Red Deer, Alta., $4,500; Whitewood, Sask., $4,000; Nokomis, Sask., $8,000; Delta, Man., $10,000; Sydney Mines, C.B., $25,000; Hawkesbury, Ont., $9,400; Killarney, Man., $10,000; Invermay, Sask., sidewalks, $1,000; Carleton County, N.B., $26,000; Madawaska County, $12,000.

**Ontario.**

GUELPH.—The ratepayers will vote on by-laws to authorize the erection of two new bridges, and also for local improvements, the cost of which will be covered by the issuance of debentures.

ORANGEVILLE.—The by-law to raise $7,800 for the purpose of erecting bridges in the township of Amaranth was carried by a majority of 37.

BARRIE.—The by-law granting a loan of $20,000 to the Barrie Carriage Company for the extension of its plant, was passed.

PORT ARTHUR.—The following by-laws have passed: $25,000 a year for ten years, and a free site, to the Western Drydock and Shipbuilding Company, who will erect a million dollar plant; $3,500 to purchase the plant and equipment of the Bell Telephone Company; sewerage and waterworks extensions and double-tracking street railway.

**Manitoba.**

ST. BONIFACE.—The ratepayers will vote on by-law authorizing the raising of $10,000 for the erection of a clock tower on the city hall.

ST. VITAL.—The municipality have read for the first time a by-law to provide for a supply of water. E. A. Poulain is secretary-treasurer.

**Quebec.**

HULL.—August 30 has been fixed as the date upon which the citizens will vote on a by-law to raise $115,000 for civic purposes.

LA COTE DES NEIGES WEST.—Until Aug. 17th for $15,000 5 per cent. 25-year bonds, L. A Guimond, secretary-treasurer, will receive tenders.

**Saskatchewan.**

MOOSE JAW.—$35,000 electric light extension, $10,000 bridge, and $25,000 school debentures are offered for sale by this municipality.

WEYBURN.—This town will sell debentures to complete the waterwork system. The issue amounts to $75,000, which will make the total debenture liability of the town approximately $150,000.

MOOSE JAW.—This city will issue $45,000 debentures to cover the cost of constructing walks.

MELVILLE.—The citizens have passed a by-law authorizing the expenditure of $6,000 for drainage.

PRINCE ALBERT.—A by-law to raise $2,758 for sewer extensions has passed.

**Alberta.**

LETHBRIDGE.—A by-law to raise $28,000 for extensions to the electric light plant and for improvements to other city property, aggregating $90,000, will shortly be submitted to the ratepayers.

**British Columbia.**

VICTORIA.—The waterworks loan guarantee by-law which authorizes the borrowing of $1,350,000 for the purpose of expropriating the works of the Esquimalt Waterworks Company, and running a pipe line to Goldstream in order to take water supply from there instead of from Thetis Lake, will be voted on by the citizens on Thursday, August 26th.

## TELEPHONY.

**Ontario.**

TORONTO.—The entire telephone system of the Temiskaming and Northern Ontario Railway between North Bay and New Liskeard is being reconstructed. Two gangs of men are now engaged in the work; which will be completed in about two months. The new system will be equipped with all the most modern improvements, and will be designed to provide a convenient and efficient service to the mines and the settlers of the district. In the new depot at Cobalt an up-to-date switchboard will be installed to give a connection with the mines. The line will also be extended along the Kerr Lake branch to Kerr Lake Station, where a switchboard will be located to furnish the mines of that section with means of communication with the outside world. It is the hope of the commissioners that the line will ultimately be extended to Cochrane, the terminus of the provincial railway.

**British Columbia.**

VICTORIA.—The British Columbia Telephone Co. has completed a long distance line between this city and Cumberland. The line was formally opened last week. It has been in course of construction for the past six months, and is all of copper, making the transmission perfect. Nanaimo was the farthest point north reached by the telephone system formerly. The new line adds another seventy miles of wire, and gives communication with Parksville, Little Qualicum and Union Bay. At the present time the company is installing a branch exchange in Cumberland and in Courtenay. From this point it is proposed to extend the line up the Courtenay Valley and down to Comox Bay.

## MARKET CONDITIONS.

Montreal, August 19th, 1909.

Reports from the United States are satisfactory, so far as the markets for pig iron are concerned. There is always a dull spell at this time of year, so that the lack of trade at the present moment is in no way discouraging. The tone is hopeful, though here and there arise complaints that trade is not so active as it should be. The entire market is looking forward to a considerable improvement this fall and the predictions of a head official of the United States Corporation that next year should witness the biggest year's business the company ever had, is not being lost sight of. There has been quite a large enquiry from railway sources for supplies of different kinds, and large orders are being placed from time to time. No price advances have taken place in pig lately, although purchases cannot be made for future delivery at as low figures as for spot iron. This, however, is not altogether an unusual situation, it being doubtful if futures have been other than higher than spot even during the depression.

In Great Britain, the improvement reported a week or so ago continues to make itself felt. Iron prices are firmly held and changes are taking place in them from time to time without any very permanent alteration being noticeable, quotations being up one day and down the next. However, the present average is undoubtedly higher than that of a few weeks ago, and the improvement continues. The home trade is all that could be expected, and although there is little export to the Continent, there is some to Canada whence some orders for delivery before the close of navigation, are commencing to arrive.

Locally, the situation continues steady. Trade is moderately active and the outlook for prices in the future is very firm. Orders are now being placed for fall delivery and it looks as though the consumption would be fairly active. In the list of products mentioned below, very few changes have been made, spikes being firmer, however, and some lumber prices being lower, although the lumber market is fairly hopeful:

**Antimony.**—The market is steady at 8¾ to 9c.

**Bar Iron and Steel.**—Prices are steady and trade is quiet. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.90 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; smooth finish, $2.70; imported, $2.20.

**Boiler Tubes.**—The market is steady, quotations being as follows:—1½ and 2-inch tubes, 8¼c.; 2½-inch, 10c.; 3-inch, 11¼c.; 3½-inch, 14 1-2c.; 4-inch, 18 1-2c.

**Building Paper.**—Tar paper, 7, 10, or 16 ounces, $1.80 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, 40c. per roll of 400 square feet; dry sheathing, No. 1, 30 to 40c. per roll of 400 square feet; tarred fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

**Cement.**—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2½ cents extra, or 10c. per bbl. weight.

**Chain.**—The market is steady as follows:—¼-inch, $5.30; 5-16-inch, $4.05; ⅜-inch, $3.65; 7-16-inch, $3.45; ½-inch, $3.20; 9-16-inch, $3.15; ⅝-inch, $3.05; ¾-inch, $3; ⅞-inch, $2.95; 1 inch, $2.95.

**Coal and Coke.**—Anthracite, egg, stove or chestnut coal, $6.75 per ton, net; furnace coal, $6.50, net. Bituminous or soft coal: Run of mine, Nova Scotia coal, carload lots, basis, Montreal, $3.85 to $4 per ton; cannel coal, $9 per ton; coke, single ton, $5; large lots, special rates, approximately $4 f.o.b., cars, Montreal.

**Copper.**—Prices are strong at 13¾ to 14c.

**Explosives and Accessories.**—Dynamite, 50-lb. cases, 40 per cent. proof, 15c. in single case lots, Montreal. Blasting powder, 25-lb. kegs, $2.25 per keg. Special quotations on large lots of dynamite and powder. Detonator caps, case lots, containing 10,000, 75c. per 100; broken lots, $1; electric blasting apparatus:—Batteries, 1 to 10 holes, $15; 1 to 20 holes, $25; 1 to 30 holes, $35; 1 to 40 holes, $50. Wire, leading, 1c. per foot; connecting, 50c. per lb. Fuses, platinum, single strentgh, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

**Galvanized Iron.**—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.40; Comet, $4.25; Gorbal's Best, $4.25; Apollo, 10¾ oz., $4.35. Add 25c. to above figures for less than case lots; 26-gauge is 25c. less than 28-gauge. American 28-gauge and English 26 are equivalents, as are American 10¾ oz., and English 28-gauge.

**Galvanized Pipe.**—(See Pipe, Wrought and Galvanized).

**Iron.**—The outlook is strong. The following prices are for carload quantities and over, on dock, Montreal: No. 1 Summerlee, $20; selected Summerlee, $19.50; Clarence, $17; Midland or Hamilton pig is quoted at $19.50 to $20, Montreal. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron special, $19.50; Carron soft, $19.25.

**Laths.**—See Lumber, etc.

**Lead.**—Prices are about steady, at $3.55 to $3.65.

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

**Lumber, Etc.**—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight rate of $1.50. Red pine, mill culls out, $18 to $22 per 1,000 feet; white pine, mill culls, $16 to $17. Spruce, 1-in. by 4-in. and up, $15 to $17 per 1,000 ft.; mill culls, $12 to $14. Hemlock, log run, culls out, $13 to $15. Railway Ties; Standard Railway Ties, hemlock or cedar, 35 to 45c. each, on a 5c. rate to Montreal. Telegraph Poles: Seven-inch top, cedar poles, 25-ft. poles, $1.35 to $1.50 each; 30-ft., $1.75 to $2; 35-ft., $2.75 to $3.25 each, at manufacturers' points, with 5c. freight rate to Montreal. Laths: Quotations per 1,000 laths, at points carrying $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, $2.50; XXX, $3.

**Nails.**—Demand for nails is better, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices. Wire roofing nails, 5c. lb.

**Paints.**—Roof, barn and fence paint, 90c. per gallon; girder, bridge, and structural paint for steel or iron—shop or field—$1.20 per gallon, in barrels; liquid red lead in gallon cans, $1.75 per gallon.

**Pipe.—Cast Iron.**—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for

5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

**Pipe.—Wrought and Galvanized.**—Demand is much better and the tone is firm, though prices are steady, moderate-sized lots being: ¼-inch, $5.50 with 63 per cent. off for black, and 48 per cent. off for galvanized; ⅜-inch, $5.50, with 59 per cent. off for black and 44 per cent. off for galvanized; ½-inch, $8.50, with 69 per cent. off for black, and 59 per cent. off for galvanized. The discount on the following is 72½ per cent. off for black, and 62½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-nch, $27; 2-inch, $36; 2½-inch, $57.50; 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

**Plates and Sheets,—Steel.**—The market is steady. Quotations are: $2.20 for 3-16; $2.30 for ⅛, and $2.10 for ¼ and thicker; 12-gauge being $2.30; 14-gauge, $2.15; and 16-gauge, $2.10.

**Rails.**—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location.

**Railway Ties.**—See lumber, etc.

**Roofing.**—Ready roofing, two-ply, 70c. per roll; three-ply, 95c. per roll of 100 square feet. Roofing tin caps, 6c. lb; wire roofing nails, 5c. lb. (See Building Paper; Tar and Pitch; Nails, Roofing).

**Rope.**—Prices are steady, at 9c. per lb. for sisal, and 11c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $6; ⅝, $7.25; ¾, $8.50; ⅞, $10; 1-in., $12 per 100 feet.

**Spikes.**—Railway spikes are steady at $2.35 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $2.85 per 100 pounds, base of ⅝ x 10-inch, and ⅝ x 12-inch.

**Steel Shafting.**—Prices are steady at the list, less 25 per cent. Demand is on the dull side.

**Telegraph Poles.**—See lumber, etc.

**Tar and Pitch.**—Coal tar, $3.50 per barrel of 40 gallons, weighing about 500 pounds; roofing pitch, No. 1, 70c. per 100 pounds; and No. 2, 55c. per 100 pounds; pine tar, $8.50 per barrel of 40 gallons, and $4.75 per half-barrel; refined coal tar, $4.50 per barrel; pine pitch, $4 per barrel of 180 to 200 pound. (See building paper; also roofing).

**Tin.**—Prices are unchanged, at 32 to 32½c.

**Zinc.**—The tone is steady, at 5¾ to 6c.

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Toronto, August 19th, 1909.

The local market is quiet and price changes are trifling. The demand for brick is still good as is also the case with lumber.

The demand for pig iron greatly exceeds the supply and prices are sure to rise. Copper on the other hand is quiet and although there are many enquiries there is no great rush of purchasers.

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

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

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

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

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

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

**Building Paper.**—Plain, 30c. per roll; tarred, 40c. per roll. Season over, nothing doing.

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

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

**Cement.**—Cement is being offered at the low price of $1.55 per barrel in car lots, including cotton bags, and sales have been made within the month at 5c. less than this. Until the consumption increases, prices will not improve. Smaller dealers report a fair movement in small lots at $1.40 per barrel in load lots delivered in town, bags extra. In packages, $1.40 to $1.50, including paper bags.

**Coal.**—Retail price for Pennsylvania hard, $6.75 net, steady. This price applies to grate, egg, stove, and chestnut; only pea coal is cheaper, namely, $5.75. These are all cash, and the quantity purchased does not affect the price. Soft coal is in good supply, American brokers have been covering the ground very fully. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, $2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, $2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.25 to $5.50; Reynoldsville, $4.50 to $4.75; Connellsville, 72-hour coke, $5.25 to $5.50.

**Copper Ingot.**—The market outside is higher and was excited yesterday. But we quote still $13.85 to $14.05 in this market, with a fair movement.

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

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

**Roofing Felt.**—An improvement in demand of late, no change in price.

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

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

**Galvanized Sheets.**—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.05; 12-14-gauge, $3.15; 16, 18, 20, $3.35; 22-24, $3.50; 26, $3.75; 28, $4.20; 29, $4.50; 10¾, $4.50 per 100 lbs. Fleur de Lis—28-gauge, $4.30; 26-gauge, $4.05; 22-24-gauge, $3.50. Queen's Head—28-gauge, $4.50; 26-gauge, $4.25, per 100 lbs. Sheets continue in active request.

**Iron Chain.**—¼-inch, $5.75; 5-16-inch, $5.15; ⅜-inch, $4.15; 7-16-inch, $3.95; ½-inch, $3.75; 9-16-inch. $3.70; ⅝-inch, $3.55; ¾-inch, $3.45; ⅞-inch, $3.40; 1-inch, $3.40, per 100 lbs.

**Iron Pipe.**—Black, ¼-inch, $2.03; ⅜-inch, $2.26; ½-inch, $2.63; ¾-inch, $3.16; 1-inch, $4.54; 1¼-inch, $6.19; 1½-inch, $7.43; 2-inch, $9.90; 2½-inch, $15.81; 3-inch, $20.76; 3½-inch, $26.13; 4-inch, $29.70; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.31; 1-inch, $6.19; 1¼-inch, $8.44; 1½-inch, $10.13; 2-inch, $13.50, per 100 feet. Some talk of an advance in price.

**Lead.**—Prices steady outside. This market is steadier, and demand rather better at $3.75 to $3.85 per 100 lbs.

**Lime.**—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. In active demand.

**Lumber.**—The local demand for stuff is maintained, but there is not so much doing outside. Southern pine continues to move, and the stock on hand is depleted. Spruce flooring is not so much heard of here, since better prices can now be had for spruce at home in New Brunswick and Quebec. Hemlock is steady, but not active. Lath are held stiffly at quotations, and none too plentiful; many are being made up north to go to the States. The 32-inch lath, so long a feature of the market, are nearly all gone. We quote dressing pine, $32 to $35 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22; shingles, British Columbia, $3.20; lath, No. 1, $4.25; No. 2, $3.75; for white pine, 48-inch; for 32-inch, $1.60, and very few to be had.

**Nails.**—Wire, $2.25 base; cut, $2.70; spikes, $3, per keg of 100 lbs.

**Pitch and Tar.**—Pitch, demand moderate, price so far unchanged at 70c. per 100 lbs. Coal tar fairly active at $3.50 per barrel.

**Pig Iron.**—There is fair activity and prices are maintained. Clarence quotes at $20.50 for No. 3; Cleveland, $20.50 to $21; in Canadian pig, Hamilton quotes $19.50 to $20 per ton.

**Plaster of Paris.**—Calcined, New Brunswick, hammer brand, wholesale, $2; retail, $2.15 per barrel of 300 lbs.

**Putty.**—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.05.

**Ready Roofing.**—More demand during the past few days, at catalogue prices before quoted.

**Roofing Slate.**—Most of the slate used in Canada comes now from Pennsylvania or Maine, the Canadian supply being slender and mostly from the Rockland quarries of the Eastern Townships in Quebec. There is a great variety of sizes and qualities, so that it is difficult to indicate prices. But No. 1 Pennsylvania slate 10 x 16 may be quoted at $7.25 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less.

**Rope.**—Sisal, 9½c. per lb.; pure Manila, 12½c. per lb., Base.

**Sewer Pipe.**—

| | 4-in. | 6-in. | 9-in. | 10-in. | 12-in. | 24-in. |
|---|---|---|---|---|---|---|
| Straight pipe per foot ...... | $0.20 | $0.30 | $0.65 | $0.75 | $1.00 | $3.25 |
| Single junction, 1 or 2 ft. long | .90 | 1.35 | 2.70 | 3.40 | 4.50 | 14.65 |
| Double junctions .......... | 1.50 | 2.50 | 5.00 | .... | 8.50 | ..... |
| Increasers and reducers .... | .... | 1.50 | 2.50 | .... | 4.00 | ..... |
| P. traps .................. | 2.00 | 3.50 | 7.50 | .... | 15.00 | ..... |
| H. H. traps ................ | 2.50 | 4.00 | 8.00 | .... | 15.00 | ..... |

Business steady; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance.

**Steel Beams and Channels.**—Quiet. We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

**Steel Rails.**—80-lb., $35 to $38 per ton. The following are prices per gross ton, for 500 tons or over: Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

**Sheet Steel.**—Market steady, at the former prices; 10-gauge, $2.50; 12-gauge, $2.55; American Bessemer, 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a quantity of light sheets moving.

**Tank Plate.**—3-16-inch, $2.40 per 100 lbs.

**Tool Steel.**—Jowett's special pink label, 10½c. Cammel-Laird, 16c. "H.R.D." high speed tool steel, 65c.

**Tin.**—After some ups and downs this week the London market showed an advance. We still quote 31c. to 31½c.

**Wheelbarrows.**—Navvy, steel wheel, Jewel pattern, knocked down, $21.60 per dozen; set up, $22.60. Pan Canadian, navvy, steel tray, steel wheel, per dozen, $3.30 each; Pan American, steel tray, steel wheel, $4.25 each.

**Zinc Spelter.**—A very active movement continues, and the market is firm at $5.50 to $5.75.

## CAMP SUPPLIES.

**Beans.**—Hand Picked, $2.60 to $2.70; prime, $2.40 to $2.50; Rangoon, hand-picked, $1.90 to $2.

**Butter.**—Dairy prints, 20 to 21c.; creamery rolls, 24 to 25c.

**Canned Goods**—Peas, 77½ to $1.12½; tomatoes, 2s, 85 to 90c.; tomatoes, 3s, 95c. to $1; pumpkins, 3s, 80 to 85c.; corn, 85 to 95c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.90 to $1.95; raspberries, 2s, $1.90 to $1.95.

**Cheese.**—No old cheese on hand; new cheese, large, 12¾c.; twins, 13c.

**Coffee.**—Rio, green, 10 to 12½c.; Mocha, 21 to 23c.; Java, 20 to 31c.; Santos, 11 to 15c.

**Dried Fruits.**—Raisins, Valencia, new, 6 to 6¼c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, 7½ to 9c.; fancy, 11 to 12c.; extra fancy, 14½ to 15c.; Filiatras currants, 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits,—Evaporated apricots, 12 to 15c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 8c.

**Eggs.**—New laid, 24 to 25c. per dozen, in case lots.

**Lard.**—Now quite scarce. Tierces, 14¼c.; tub, 14¾c.; pails, 15c. per lb.

**Molasses.**—Barbadoes, barrels, 37 to 45c.; Porto Rico, 45 to 60c.; New Orleans, 30 to 33c. for medium.

**Pork.**—Short cut, $25 to $26 per barrel; mess, $23.50.

**Potatoes.**—Ontario, old, 75 to 90c. per bag in car lots on track.

**Rice.**—B grade, 3½c. per lb.; Patna, 5½ to 5¾c.; Japan, 5¼ to 6c.

**Salmon.**—Fraser River, talls, $2; flats, $2; River Inlet, $1.55 to $1.75.

**Smoked and Dry Salt Meats.**—Long clear bacon, 13¾c. to 14c.; firm, tons and cases; hams, large, 13 to 14c.; small, 15½ to 16c.; rolls, 13 to 13½c.; breakfast bacon, 17c.; backs (plain), 17½c. to 18c.; backs (peameal), 18c. to 18½c.; shoulder hams, 12c.; green meats out of pickle, 1c. less than smoked.

**Spices.**—Allspice, 16 to 19c.; nutmegs, 30 to 75c.; cream tartar, 22 to 25c.; compound, 15 to 20c.; pepper, black, pure Singapore, 14 to 17c.; pepper, white, 20 to 30c.

**Sugar.**—Granulated, $4.75 per 100 lbs. in barrels; Acadia, $4.65; yellow, $4.35; bags, 5c. lower; bright coffee, $4.60; bags, 5c. less.

**Syrup.**—Corn syrup, special bright, 3½c. per lb.

**Teas.**—Japans, 18 to 35c. per lb.; Young Hysons, 16 to 35c.; Ceylons, medium, 16 to 45c.

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Winnipeg, August 17th, 1909.

The local market is quiet but the demand for small lines continues steady and there is nothing of special importance to record. Favorable building conditions still continue, and the number of dwellings that are being erected in the residential portion of the city is surprising and the demand for builders material keeps business with the supply dealers fairly steady. Lumber is in good demand also shingles and lath. The hardware dealers report a good demand for building paper and wire nails. Harvesting operations are now on in the country and country orders are practically at a standstill. The mid-summer hot weather and holiday season is also having its effect on the market, but for all this it is surprising how the demand for small lines keeps up.

Cement is again somewhat quiet and prices are pared down very low. A good demand is also noted for a better class of brick this season.

Winnipeg quotations are as follows:—

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

**Axes.**—Chopping axes, per dozen, $6 to $9; double bits, $12.10 per dozen.

**Barbed Wire.**—4 point and 2 point, common, $3.15 per cwt.; Baker, $3.20; Waukegan, $3.30.

**Bar Iron.**—$2.50 to $2.60.

**Bars.**—Crow, $4 per 100 pounds.

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

**Boards.**—No. 1 Common Pine, 8 in. to 12 in., $38 to $45; siding, No. 2 White Pine, 6 in, $55; cull red or white pine or spruce $24; No. 1 Clear Cedar, 6 in., 8 to 16 ft. $60; Nos. 1 and 2 British Columbia spruce, 4 to 6 in $55; No. 3, $45.

**Bricks.**—$10, $11, $12 per M, three grades.

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

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

**Copper Wire.**—Coppered market wire, No. 7, $4 per 100 lbs.; No. 6, $4; No. 10, $4.06; No. 12, $4.20; No. 14, $4.40; No. 16, $4.70.

**Copper.**—Tinned, boiler, 26½c.; planished, 29½c.; boiler and T. K. pits, plain, tinned, 45 per cent. discount.

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

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

**Dynamite.**—$11 to $13 per case.

**Hair.**—Plasterers', 80 to 90c. per bale.

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

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

**Galvanized Iron.**—Apollo, 10¾, $4.90; 28, $4.70; 26, $4.30; 22, $4.10; 24, $4.10; 20, $4; 18, $3.95; 16, $3.90; Queen's Head, 28, $4.90; 26, $4.70; 24, $4.30; 22, $4.30; 20, $4.10 per cwt.

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

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

**Lumber.**—No. 1 pine, spruce, tamarac, British Columbia fir and cedar—2 x 4, 2 x 6, 2 x 8, 8 to 16 feet, $26.00; 2 x 20 up to 32 feet, $36.50.

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

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

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





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

**Plaster.**—Per barrel, $3.

**Roofing Paper.**—60 to 67½c. per roll.

**Rope.**—Cotton, ¼ to ½-in. and larger, 23c. lb.; deep sea, 16½c.; lath yarn, 9½ to 9¾c.; pure Manila, per lb., 13¼c.; British Manila, 11¾c.; sisal, 10½c.

**Spikes.**—Basis as follows:—1¼ x 5 and 6, $4.75; 5-16 x 5 and 6, $4.40; ⅜ x 6, 7 and 8, $4.25; ½ x 8, 9, 10, and 12, $4.05; 25c. extra on other sizes.

**Steel Plates, Rolled.**—3-16-in., $3.35 base; machinery, $3 base; share, $4.50 base; share crucible, $5.50; cast share steel, $7.50; toe calk, $4.50 base; tire steel, $3 base; cast tool steel, lb., 9 to 12½c.

**Staples.**—Fence, $3.40 per 190 lbs.

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

**Tool Steel.**—8½ to 15c. per pound.

**Wire.**—Oiled and annealed, 8 and 9 gauge, $3 per cwt.; 10 gauge, $3.06; 11 gauge, $3.12; 12 and 13 gauge, $3.20; 14 to 16 gauge, $3.25 to $3.70; 10c. extra for oiling.