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The Canadian Engineer

WEEKLY

ESTABLISHED 1893.

VOL. 18. TORONTO, CANADA, JUNE 16th, 1910. No. 24.

The Canadian Engineer

ESTABLISHED 1893.

Issued Weekly in the interests of the

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

Editor.—E. A. James, B.A.Sc.
Business Manager.—James J. Salmond.
Advertising Manager.—A. E. Jennings.

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Canada and Great Britain:		United States and other Countries:	
One Year	**$3.00**	**One Year**	**$3.50**
Six Months	**1.75**	**Six Months**	**2.00**
Three Months	**1.00**	**Three Months**	**1.25**

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Changes of advertisement copy should reach the Head Office by 10 a.m. Friday preceding the date of publication, except in cases where proofs are to be mailed to distant points, for which due time should be allowed.

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

Index of this issue will be found on page 624.

CANADIAN GAS ASSOCIATION.

The third annual meeting of the Canadian Gas Association was held at Hamilton on June 9th, 10th and 11th.

For some time past the interest taken in hydro-electric matters has prevented the growth and expansion of gas companies and gas plant installation in Canada. Now that the air has cleared a little in reference to cost of electric installations, and business methods instead of public promises are being considered, gas installations will again be figured on more extensively.

In the addresses at the Hamilton convention the advantages of gas for lighting, heating and power purposes were fully discussed, and it was informing to listen to managers of plants municipally-owned, which had both electrical and gas lighting to handle, refer to the splendid work done by gas when in competition with electricity.

The bringing together of the men closely associated with the gas industries of Canada, the exchange of ideas, and the united action and investigation will be appreciated throughout the year by their customers and the general public.

DEVELOPMENTS IN NOVA SCOTIA.

The Halifax Board of Trade recently tendered Mr. J. H. Plummer, president of the Dominion Steel and Coal Corporation, a luncheon. Mr. Plummer's address was listened to with great interest, and, as he described the development of this trading concern, two things stood out prominently in the address. First, that twelve thousand names were on the pay roll, and that for wages alone they pay annually $8,000,000. Second, the possibility of immediate expansion of the plant, so that wire, wire nails and other finished products might be turned out from their factory. This is a new departure on behalf of this concern.

This indicates that the company have not as yet reached the limit of their possibilities for expansion. New furnaces will be built, new mills erected, and with these increased facilities and the possibilities of cheap raw material the development of these new branches of their industry will likely be rapid.

CANADIAN GAS EXHIBITORS.

The Canadian Gas Exhibitors held their first exhibition at Alexandria Rink, Hamilton, from June 6th to 11th.

The exhibition was one which pleased both the exhibitors and the visitors. Considerable time and money had been spent in securing the effect which not only added to the beauty of each individual exhibit, but which made the whole building appear as one specially arranged for the purpose. To Archibald W. Smith, secretary-treasurer of the Canadian Gas Exhibitors, much of the credit for the success of the exhibition is due. Mr. Smith was fortunate in his selection of his exhibitors, so that the exhibits illustrated almost every phase of work in connection with gas plants.

The directors are to be congratulated that their first effort was so successful. Each year the display and interest in this work will increase, and those connected with the production of machinery and special fittings, as well as those anxious to purchase equipment for gas plant, will look forward to this annual convention with pleased concern.

EXPERT ADVICE.

The city of Regina recently awarded contracts for street pavement against the direct recommendation of the city commissioner and the city engineer.

Municipal corporations engage their city engineers and commissioners that they may have business men with expert knowledge to direct and regulate the business of the municipality. These men devote their time and energy to equipping themselves for the particular work they have to undertake. The practice of ignoring the recommendations of these men is becoming too common. City councils too frequently constitute themselves into a board of advisory engineers.

In the matter under discussion at Regina it was pointed out quite clearly that the class of pavement that the council accepted had not been tested in Canada; that there were several pavements which had been tested, and that these pavements could be secured.

The city councils have taken upon themselves the selection of a certain pavement. If this fails, the engineer and the works department of the city will suffer.

We believe the city engineers, where they are given a free hand, are quite willing to take the blame and responsibility for work done, and we do not think it any answer for the city councils to say that "We are the taxpayers, and it is for us to say whether we will accept certain work or not."

They engage their city engineer for particular work. If they have not confidence in him, it would be better to secure a new engineer than to go against his recommendations.

It is true that the city engineers are the servants of the municipality, and answer directly to the council, but it is also true that they have a responsibility to the taxpayers, and that as such it is their duty to see that the taxpayer gets a square deal as it is to cater to the wishes of the council.

EDITORIAL NOTES.

The month of April, 1910, shows an increase of almost 44 per cent. in building permits in Canadian cities over those issued in April, 1909. For April, 1910, the permits were $12,293,000. For 1909, $8,553,000. This refers to twenty-six of the largest Canadian towns and cities.

* * * *

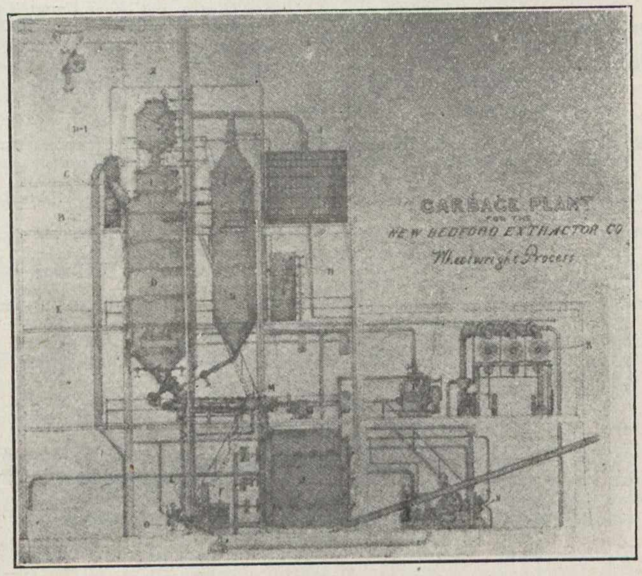
Four years ago the Macmillan Company commenced to do business in Canada under the Canadian charter. The past few years have seen such development in their Canadian trade that they have found it necessary to erect a large and commodious office building. St. Martin's House, Bond Street, Toronto, will be the head office of their Canadian business. The new home of the Canadian Macmillan Company is fortunate in its surroundings, convenient in arrangement, and has a light and space and tasteful lay-out that makes it the most attractive publishing office in Canada.

GARBAGE REDUCTION AND DISPOSITION OF THE BY-PRODUCTS.*

By Charles S. Wheelwright, President International Continuous Filter Press Company.

The Wheelwright hot water reduction process having been in practical operation for the past six years, has without question demonstrated that the past objections as to sanitary conditions and danger of fire or explosion from volatile grease solvents have been overcome, and it is acknowledged by experts that they can recommend the erection of plants in locations best suited to economical collection of garbage.

The special machinery required is constructed of metal which the inventor has had in successful use for the past twenty-five years in the manufacture of sulphite pulp for paper making, which gives assurance of its durability, being



capable of withstanding acid, hence the question of maintenance is reduced to a minimum by that as well as the heavy construction of the apparatus.

The objections to assembling wagons at a given point are overcome, as the arrangements are such that many wagons can be unloaded under cover at one time, and the garbage deposited into vaults and there fed to the apparatus without drying, grinding or disintegrating, which is not necessary by the Wheelwright process; this handling being done in a comparatively air-tight room ventilated under forced draft. On leaving this vaulted room, the garbage with its by-products, grease and tankage, is worked continuously through the plant and is not again exposed. All vapor and gases are confined and condensed, no odor being perceptible at any time throughout the plant.

The increasing value of garbage grease for many uses. especially in producing "red oil" for wool scouring, should insure its recovery in any location, even where the tankage might not be disposed of to good advantage as fertilizer.

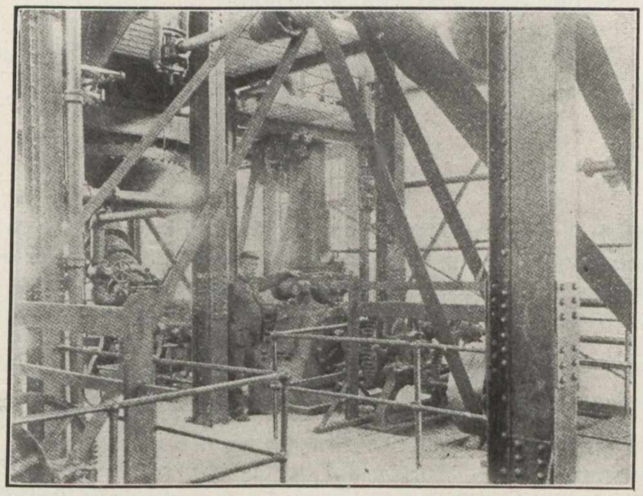
Reduction means a separation by the householders of their waste, but a revenue from the operation under the Wheelwright hot water process.

*Read at the American Society of Municipal Improvements.

For 100,000 inhabitants, the cost of a Wheelwright process plant complete should not exceed $65,000 in the east, above the foundation, with building of the design of either cut, which would be of fire proof construction.

Figure 3 shows the internal elevation and the installation of the apparatus for a sixty-ton plant by our intermittent process, which means charging, cooking and discharging. Cooking requires four to five hours; the other operations are governed by the capacity of digester, or at the rate of five tons per hour for charging and eight tons per hour for discharging, adding two hours for blowing down. Total sixteen hours for a digester of thirty tons capacity, when tankage is intended to produce good fertilizer. For the extraction of grease only, the time will be much shortened.

The operation of the process commences from the delivery of the garbage from the vault to the conveyer, which feeds it to the digester through an air-tight draft tube so connected with the charging hole of the digester as to prevent the escape of any odor or vapor, only through the exhaust fan, which discharges into a special water condenser, its duct leading to the generating boiler furnace to insure against the escape of any gases.



Machinery of New Bedford Garbage Reducing Plant.

Before the charging is put in operation, garbage liquor that has been drained from the garbage at the racks in the vault and delivered to the hot water tank adjacent to the digester, is furnished to fill the cone; steam is admitted at the bottom side of the cone to bring the liquor to 212 degrees, charging is then commenced and the contents allowed to boil throughout the time of charging, which is stopped only when digester is full to charging hole; then it is sealed. The object of this treatment is to insure a perfect cook, which would be impossible if charged with cold garbage. When sealed and further charged with garbage liquor from the hot water tank, more steam is turned on to digester to raise the pressure to twenty-five pounds as quickly as possible. An iron grating just above the charging hole prevents any of the solid matter from passing upward to the receiver on top of the digester. The said receiver is so connected that an 8-inch stand-pipe is arranged to extend up inside to prevent the flow back of the grease and liquor that discharges through it by pumping up of garbage liquor from the hot water tank, or the condensation from cooking. Test glasses and gauge cocks are so arranged that the tender can readily see the line of water and grease, so that he may keep that line below the top of the stand-pipe, before described, by drawing off the grease and water, the grease going to the separator tank with some water, the water to the hot water tank. This continues during cooking, as well as the continuous blowing off of gases into same tank, until ready to "blow down," then the steam is shut off at the bottom of the digester and the blow-off pipe is opened to the hot water tank or to another digester ready to be cooked, enough always to be turned into the tank to keep the water hot. The vapors and odors created in tank are exhausted through the water condenser.

The pressure having been reduced in the digester, the 16-inch gate valve at the bottom, connecting with extractor, is opened and the machine started, delivering the tankage through its automatic discharge at the end with not over 50 per cent. of moisture, which can be reduced where conditions require it, and about 3 to 4 per cent. of grease to the dry tankage, which is about 15 per cent. of garbage treated. The balance of the liquor and grease pass to the filter plate of the extractor as the matter is expressed, until the digester is emptied.

The water and grease so extracted go to the traps to be separated, and the tankage for further treatment.

The above is an outline of our intermittent process. From the knowledge gained by our experience in handling city waste for the past six years, it has become evident that in certain localities, and, perhaps, from a municipal ownership standpoint, it would not be feasible to utilize tankage as a fertilizer, which led Mr. Wheelwright to take out his patent of June 22, 1909, for the treatment of garbage for the extraction of grease by a continuous process, charging and discharging a digester while under steam pressure, extracting the grease and delivering the tankage continuously in regular quantities to a furnace or incinerator to be destroyed with other wastes or with coal, that its value may be recovered by being utilized to generate power.

This method will extract more of the grease from the garbage and of better quality than that obtained by solvents, and at the same time with less spent liquor, as it shortens the time that the garbage is exposed to steam pressure, thereby making a great saving in water of condensation, allowing a regular supply of moisture from said spent liquor to be utilized in regulating the furnace where combustion takes place.

We are aware that exhaustive experiments have been made during the past two years that show value in the power generated in destroying city waste by incineration, which gives reason to believe that a portion of the expense of incineration can be partially eliminated. Tankage has a value as fuel, after the grease has been extracted, equal to green garbage in connection with rubbish and ashes when utilized to generate power, part of which can be readily used in the reduction, the remainder to be sold in the form of electric power, giving a credit against the cost of incineration, in addition to the value of the grease, which can be safely placed at not less than $2.25 per ton of green garbage at a cost of not over $1.25 per ton by our method of reduction. This combination must show an advantage to both methods, i.e.: The incinerator as a power plant, and reduction as a producer of revenue, each helping the other in the cost of construction and operation. The spent liquors from reduction, from which the ammonia has been extracted, to protect the incinerators from destruction in regulating the temperature.

To husband our resources is in the mind of every thoughtful person. To destroy anything of value is wrong, and in this connection the treatment of sludge from sewage should be considered, from the fact that there is much of the sludge that would be combustible if properly prepared for the furnaces. This led Mr. Wheelwright to the invention of a continuous filter press; the patents are allowed, and will be issued by the United States and foreign countries before this article is read, and we hope shortly to be able to give a public demonstration of the value of this apparatus and shall then take pleasure in notifying the American Society of Municipal Improvements.

CAR WEIGHTS AS AFFECTING OPERATING COST.*

By M. V. Ayres, Electrical Engineer, Boston & Worcester Street Railway.

(Concluded).

Data are lacking with which to make a close analysis of the variation of these factors of car repairs cost, but their nature, as above stated, points strongly to an equation of the same type as that given for power consumption.

If R = cost of car repairs in cents per car mile,

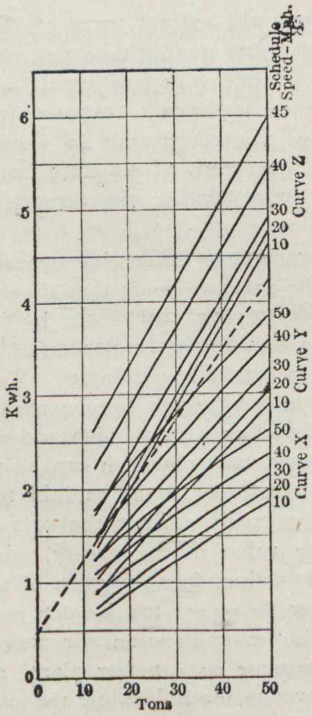
$$R = ar + brW.$$

From data of the ratio of cost of repairs to cost of power on a number of large systems, it is believed that values of ar and br, as given in the following equation, are about correct:

$$R = .46 + .07\ W.$$

Cost of Track Repairs.

It is evident that a certain part of the cost of track repairs would be incurred irrespective of use, as decay of ties and corrosion of metals, and injury from teaming would go on just the same. Otherwise, wear is evidently about proportional to ton mileage. If track construction is much too light for the car weight, doubtless the wear would increase faster than the weight, but with tracks suitable to the traffic, it is probably closely proportional.



Car Weights—Fig. 4.

This evidently again calls for an equation similar to that for power consumption.

If T = cost, in cents per car mile, of track repairs,

$$T = at + btW.$$

The relative values of at and bt will depend upon the proportion of natural deterioration to wear, at increasing with decreased frequency of service, and with increased use of the road-bed for other traffic.

Both at and bt will vary with the weight of rail, quality of ballast, and other details of track construction.

It is believed that the following equation gives fair average values of at and bt:

$$T = .43 + .026W.$$

Fixed Charges of Power Plant.

It is evident that the size and cost of the power plant will be proportional to the power requirements of the cars, and that, therefore, the equation connecting fixed charges on power plant with car weight will be of the same type as that connecting power cost with car weight.

If C = fixed charges on power plant in cents per car mile, then,

$$C = \frac{kp}{n}(ap + bpW).$$

where k is a constant connecting fixed charges with cost of power. Assuming fixed charges at one-half the power-production cost, we have as an average value:

$$C = .333 + .05\ W.$$

Fixed Charges of Distribution System.

For any railway system, a certain minimum of investment in trolley wire and feeders is required, and in addition an investment nearly proportional to the power demand. Evidently this condition will be met by an equation of the same type.

If F = fixed charges in cents per car mile on distribution system,

$$F = af + bfW.$$

The values to be assigned to af and bf will vary enormously with different characters of road, being very much greater for the interurban than for the city system. For an interurban road it is believed that the following is a fair average:

$$F = .32 + .02\ W.$$

Total Costs Affected by Weight.

We are now in a position to construct a formula expressing the total cost of operating cars, so far as that cost is affected by car weight. Let M = total of the following costs per car mile; cost of power, cost of car repairs, cost of track repairs, fixed charges of power plant, fixed charges of distribution system.

$$M = P + R + T + C + F, \quad \text{where,}$$

$$P = \frac{p}{n}(ap + bpW)$$

$$R = ar + brW$$

$$T = at + btW$$

$$C = \frac{kp}{n}(ap + bpK)$$

$$F = af + bfW.$$

This summation will evidently take the form:

$$M = as + bsW.$$

If we substitute the average values as assumed above, this becomes,

$$M = 2.21 + .267\ W = \text{cents per car mile.}$$

This evidently means that the five items of expense above enumerated cost 2.21 cents per car mile, no matter what the weight, and in addition 0.267 cent per ton mile.

Substituting different values of W we may obtain the cost of operating cars of various weights, under the conditions assumed, for the five items of operating cost above considered.

The following table is so compiled.

Cost in Cents Per Car Mile to Operate Cars.

Weight Car. Tons.	Cost. as	bsW	Total Cost. M.
10	2.21	2.67	4.88
15	2.21	4.00	6.21
20	2.21	5.34	7.55
25	2.21	6.68	8.89
30	2.21	8.01	10.22
35	2.21	9.35	11.56
40	2.21	10.68	12.89
45	2.21	12.00	14.21
50	2.21	13.35	15.56

In estimating the expensiveness of car weight we should consider only that part of operating cost which is proportional to weight, or in the cast assumed, 0.267 cent per ton mile. If a car runs an average of 150 miles per day this amounts in a year to $150 per ton. That is to say, it costs $150 per year for every ton, or 7.5 cents per year for every pound of weight in a car.

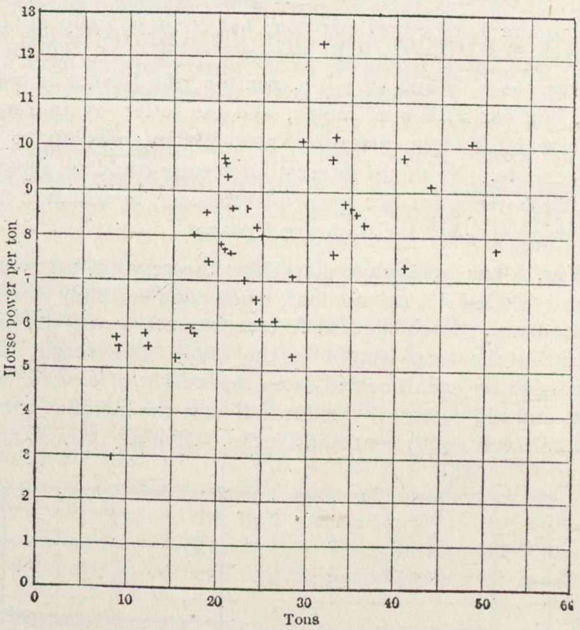
If it costs 7.5 cents per pound per year to carry around weight it evidently is worth many times that much to get rid of weight. If the car were a permanent investment it would be worth, at 5 per cent., 20 times 7.5 cents, or $1.50 for every pound we could reduce weight. If, on the other hand, we suppose that at the end of 15 years the car will be scrapped, we can consider the 7.5 cents per year saving as an annuity to continue for 15 years, and then cease. A table of annuities shows the present value of 7.5 cents for 15 years at 5 per cent. to be 78 cents. According to this we can afford to pay 78 cents per pound, or $1,560 per ton to reduce car weight.

Of course these values will vary over a wide range.

The curves of Fig. 4 show how widely the power cost will vary with different schedules. All of the other costs will vary in a similar manner. Each case must be considered on its merits. It is believed, however, that the general form of equation of the straight line intercepting the axis of Y above the origin will very closely represent the actual conditions in all cases. There will always be a portion of the operating cost, represented by a in the formula cost = a + b W, which is independent of weight, and another part which is proportional to weight. The finding of any two points on the cost line is sufficient to establish the line. For instance, if it is found that under certain conditions the operating cost for a 40-ton car is $6,000, and for a 30-ton car $5,000, it will be safe to figure the cost per ton at $100, and the formula becomes, cost = 2,000 + 100 W.

While, as above stated, the cost of carrying around weight will vary in each case, it is believed that the figure of 7.5 cents per pound per year is a fair average value and by no means an extreme case. An effort has been made to get data from various operating companies as to their estimate of this cost. Very little data have been forthcoming, but what have been secured show a general tendency in several large city systems to estimate it at 5 cents per pound per year. This is not at all inconsistent with the figure of 7.5 cents above given, which corresponds more nearly with interurban conditions. Even at 5 cents per pound per year, we can afford to pay $1,000 per ton for a reduction in car weights.

At this figure, if we could reduce the weight of a 28-ton car to 14 tons, without reducing its carrying capacity, safety or speed, we could afford to pay $14,000 more for the lighter car. Even if a much lower figure than $1,000 per ton is

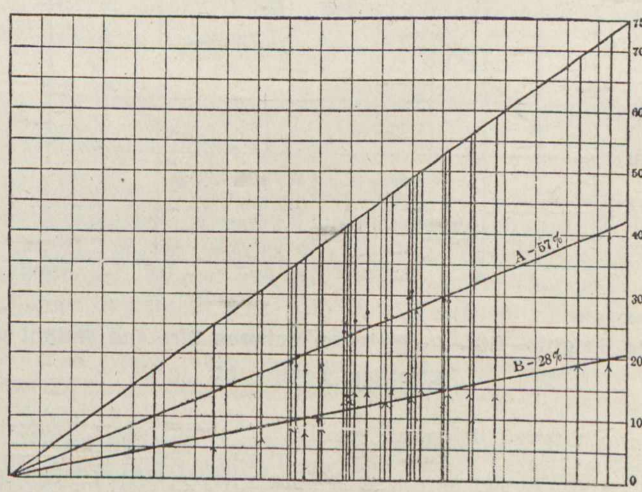


Car Weights—Fig. 5.—Motor Horsepower Per Ton for Cars in Actual Service.

taken, it is evident that it will still be a good investment to spend a great deal of time and money in solving the problems of producing lighter cars.

Electrical Apparatus.

The weight of any electrical car is partly due to its electrical apparatus. It is interesting to inquire how great a proportion of the total weight must be assigned to this purpose.



Car Weights—Fig. 6.—Relative Weights of Electrical Equipment, Trucks and Car Body.

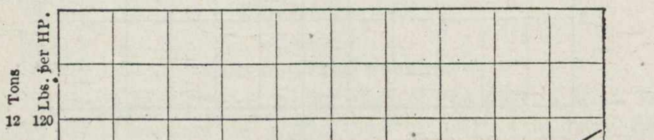
If we assume that it is permissible to load a motor to 25 per cent. over its commercial rating during acceleration, a formula for the motor horsepower required per ton would be:

$$H.P. = .208\ AS.$$

where A = rate of straight line acceleration in miles per second, and S is speed in miles per hour at the end of straight line acceleration. Seven per cent. is allowed for effect of rotating parts. For any given shape of speed-time curve, S is proportional to schedule speed, and therefore horsepower is proportional to schedule speed.

Fig. 5 shows the actual motor horsepower per ton in a number of cars in actual use, plotted with reference to weight of car. Evidently there is no relation between the weight of car and the horsepower per ton, but in practically all cases the horsepower per ton falls between 5 and 10.2. Of the two extreme cases, 3 and 12.3 h.p. per ton, the former is a light 16-ft. box car with one motor, and the latter is an English tunnel car for train operation, probably intended to be used with trailers. No doubt interesting results could be shown by plotting horsepower per ton with reference to schedule speed for these cars, but the data are lacking.

Fig. 6 has been plotted to show the relation between the weights of electrical equipment, trucks and car body of cars in common use. Each vertical line represents a car, the height indicating the total weight of the car. The height of the arrow-head on each line indicates the weight of electric equipment, and the height of the dot indicates the combined weight of the electric equipment and trucks. Sloping lines A and B,



Car Weights—Fig. 7.—Relation Between Size and Weight of Electrical Equipment.

drawn through the mean position of these points, indicate that, in general, electric equipment weighs about 28 per cent. of the total and trucks about 29 per cent., or a total for electric equipment and trucks of 57 per cent. The other 43 per cent. is apportioned to car body plus all other equipment.

Fig. 7 shows the relation between size and weight of electric equipment. The curves are plotted to give as nearly as possible the average weights of commercial equipments, the weights, including motors, gears, and all control apparatus. Curves A and B show the weight in tons of 4 and 2-motor equipments, and curves C and D show the weight in pounds per horsepower of 2 and 4-motor equipments. The 4-motor equipments are just about 40% heavier than the 2-motor of the same power for the entire range from 100 to 400 h.p. The 2-motor equipment is also cheaper in first cost and should be preferred unless more than 400 h.p. per car is required, or conditions of traction are such as to require 100 per cent. of weight on drivers.

The fact that the average car body is only 43 per cent. of the whole weight of the car should not lead to the conclusion that a reduction in the weight of car body itself is comparatively unimportant, because that can and should be accompanied by a nearly proportional reduction in the weight of motors and trucks.

In the hope of getting some indication of the direction in which to seek for weight reduction, an effort has been made to get detail weights of component parts of cars. This has met with little success. One sheet has come to hand as follows:—

Weights of Semi-Convertible Car

28-ft. body, 40 passengers, K-28-J control, 4 G E 80 motors.

Car body without seats	14,820
Seats	1,180
Trucks	14,200
Electric equipment	14,250
Air brake equipment	1,300
Hand brake	278
Wire	250
Conduit, pipe, etc.	652
Hangers, bolts, etc.	651
Heaters and switches	197
Snow scrapers, fenders, draw bars	580
Trolley base, etc.	190
Miscellaneous	152
Total	48,700

While, of course, no detail is too small to be of importance, it appears from the above list that miscellaneous fittings do not constitute a very large part of the weight. The car body itself is the best place to start to reduce weight. A lighter car body permits lighter trucks. Lighter trucks and car body require less power to move and therefore call for lighter motors.

Interest in the subject of reducing car weights seems to have been rapidly developing during the past year or two. A number of operating companies have been investigating methods of reducing weights and have made encouraging progress. One company has designed a malleable iron body bolster to take the place of a built-up steel plate bolster for its standard cars. The new bolster is shown by test to be much stronger than the old one, but is 109 lb. lighter, making a reduction of 218 lb. per car, which is a saving worth, at the average value above estimated, of 78 cents per pound, about $156 per car.

Another company has just contracted for new cars which are 2 ft. longer than their old standard, and 2,000 lb. lighter, besides being undoubtedly stronger. This result is attained by a partial steel frame construction and the use of a turtle-back roof in place of the monitor deck.

One large Eastern company has closed contracts for cars and trucks, after receiving bids upon specifications drawn to emphasize the importance of light weight. The contracts finally signed specify weight limits which must not be exceeded, and include agreements on the part of the builders to furnish the customer with detailed weights of each and every component part as actually constructed. As a result, the new cars are to be 4,000 lb. lighter than cars of the same size now in use by the company.

The double truck car body may be regarded as a bridge structure supported at the bolsters and overhung at both ends. The two car sides can be designed as trusses, resting upon and connected together by the bolsters, which are themselves shallow trusses carrying the load to the centre plates. This elementary truss frame can be designed so as to be extremely light and still be amply strong to bear its load. The simplicity of the problem is badly interfered with by the necessity for platforms, which are very awkward to attach and disproportionately heavy, and become more troublesome as their length is increased. The problem is still further complicated by the necessity of providing for drawbar strains, and the uncertainty as to the strains set up by the motion of the car.

It is probable that the correct principle to work on in designing cars for lightness is to provide first a strong steel frame to take the known strains, and secondly to use the lightest possible material for all parts intended either to separate the car interior from the outside atmosphere or to provide ornaments and conveniences.

It is noticeable that in every case brought to light in this investigation, where car weights have been reduced, this has been accomplished, at least in part, by the use of steel in place of wood. The fact is that weight for weight in almost all forms, steel is stronger than wood, the superiority becoming very pronounced in some special shapes, such as I-beams, to which steel is especially adapted. This is true of ordinary structural steel, and some of the special alloy steels are even very much stronger and undoubtedly can be advantageously used in some places.

Hard wood is heavy material. For some purposes a light wood can be used equally well and probably some form of fibre in thin sheets can take the place of wooden panels with much saving of weight. Aluminum can be used in sheets for siding and as castings to take the place of bronze fittings. Common cast iron should be excluded altogether from car construction. It has no use for which some other material would not be lighter and better.

In the matter of truck construction, probably pressed steel can be utilized to reduce weight to a marked degree. Hollow axles of high-strength steel are also a hopeful possibility.

Electric equipment can undoubtedly be reduced in weight. Probably the greatest reduction can be accomplished by designing motors for large commutating capacity and using forced ventilation. It is possible that radically new designs may be made, permitting of lighter construction. Perhaps a combined motor and truck built as one machine may solve some of the motor and truck problems.

From an engineering standpoint, the problem of transportation is primarily one of moving certain weights from point to point on the earth's surface. In the ordinary electric passenger car, the dead weight is from three to ten times the live weight when all the seats are occupied, while the average condition of loading would show a much larger proportion of dead weight. In other words, the weight efficiency is not better than from 10 to 30 per cent., under the best conditions, and drops to nearly nothing under the worst.

The reduction of the proportion of dead weight to passengers carried seems to hold out greater promise of economy than any other line of improvement at present discernible in the field of transportation engineering.

ELEMENTARY ELECTRICAL ENGINEERING.
CHAPTER III.

MAGNETO-ELECTROMOTIVE FORCE.
Generated Electromotive Force—Induced Electromotive Force—Self-induction—Mutual Induction.

L. W. Gill, M.Sc.

This series of articles will be continued for some months. They will be of particular interest to the student of electrical work and the civil engineer anxious to secure some knowledge of the simpler electrical problems.

Self-induction.—It has been noted above that the instantaneous e.m.f. induced in any circuit is equal to the rate of change of magnetic linkages. This is true for every circuit, and is independent of the method by which the change is effected. Consider now what will happen when a source of e.m.f., say, a battery, is connected to a circuit of any kind. The e.m.f. of the battery will cause a current to flow in the circuit, the value of which will increase from zero to a certain definite maximum, which is fixed according to Ohm's law. As the current increases the number of lines of force which encircle or link with it will increase in proportion. This change of linkages will induce an e.m.f. in the circuit, which will oppose the flow of current. If the battery is disconnected from the circuit when the current is flowing, the decrease in current will be accompanied by a decrease

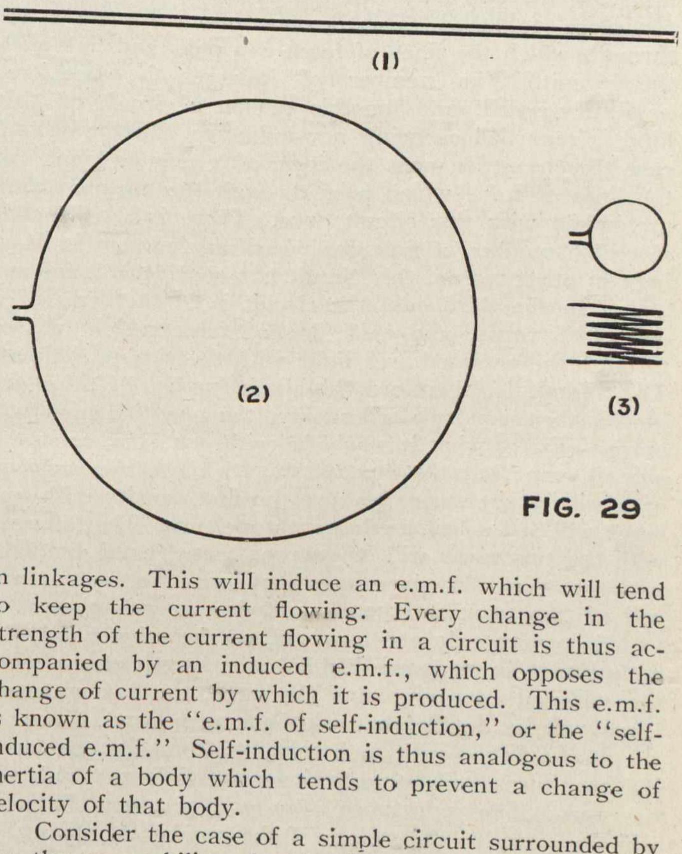


FIG. 29

in linkages. This will induce an e.m.f. which will tend to keep the current flowing. Every change in the strength of the current flowing in a circuit is thus accompanied by an induced e.m.f., which opposes the change of current by which it is produced. This e.m.f. is known as the "e.m.f. of self-induction," or the "self-induced e.m.f." Self-induction is thus analogous to the inertia of a body which tends to prevent a change of velocity of that body.

Consider the case of a simple circuit surrounded by air, the permeability of which is constant. When a current flows in such a circuit the magnetic flux, and consequently the linkages, is proportional to the strength of the current. If Q represents the linkages and I the current, then

$$Q = LI \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (13)$$

L being a constant. This equation indicates that the change of linkages which accompanies a given change of current depends on the value of L. The value of this constant thus determines the magnitude of the self-induced e.m.f. and for this reason it is known as the "coefficient or self-induction," or (more recently) the "inductance" of the circuit. When $I = 1$ in equation (13), $Q = L$. This indicates that **the inductance of a circuit is the number of magnetic linkages with that circuit, caused by unit current flowing in it.** The inductance of a circuit is, therefore, a property of a circuit

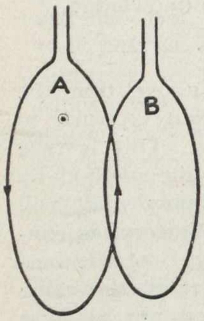


FIG. 30

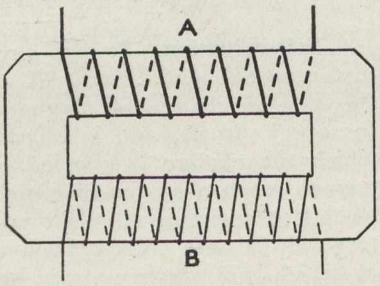


FIG. 31

which depends only on its configuration. This point will be clearly seen by comparing the circuits shown in Fig. 29. The length of wire is the same in each circuit shown, but the configuration is quite different. In the first case the two halves of the circuit are parallel, and run close together. This leaves practically no space through which the lines of force can pass and link with the circuit. The number of linkages is, therefore, negligibly small, and for this reason a circuit of this kind is regarded as being non-inductive. In the second case the circuit assumes the form of a ring or loop. All the lines of force which pass through the enclosed area are linked with this circuit once. There is thus a considerable number of linkages when unit current is flowing; in other words, this circuit has considerable inductance. In the third case the circuit is in the form of a coil of N turns, and each line of force which passes through the enclosed area links with the circuit N times. This circuit is, therefore, highly inductive. If, for example, there are two turns only, the enclosed area will be one-quarter what it would be with one turn, as in the second case; but the flux passing through the enclosed area will be the same, because the flux density with two turns will be four times that with one turn. The linkages with the two turns will, therefore, be twice the linkages with one turn. A given length of wire formed into a coil of two turns is, therefore, twice as inductive as it would be with only one turn. If, on the other hand, the second turn is made by doubling the length of the wire, the enclosed area remaining the same, the flux with two turns will be double that with one turn; and, since all the flux is linked with each turn, the total linkages with the two turns will be four times the linkages with the one turn. The inductance of a coil of given diameter will thus vary as the square of the number of turns.

The practical unit of inductance is the "henry," which may be defined as the inductance of a circuit having 10^9 linkages when one ampere is flowing in it.

From the above it is clear that **when any change of current takes place in a circuit the e.m.f. induced by the change always tends to stop the change**; when the current increases, the direction of this e.m.f. is opposite to that of the current, and when the current decreases the direction of the induced e.m.f. is the same as that of the current. An electric current thus appears to have inertia the same as a body, this inertia being measured by the inductance of the circuit through which the current is flowing. In the case of direct current circuits, in which the direction of the current does not change and the magnitude changes gradually, the induced e.m.f. is of little consequence; its tendency to maintain a constant flow and oppose rapid fluctuations in the magnitude of the current is an advantage rather than a disadvantage. In cases where the current is alternating, however; i.e., continually changing both in magnitude and direction, the inductive e.m.f. is usually very objectionable, since in this case a rapid variation in the current is the essential feature. For this reason the inductance of a circuit is of prime importance if the current is to be an alternating one.

Example 10.—Six coils, each wound with 800 turns, are connected in series. When a current of eight amperes is flowing in these coils the flux passing through each coil is 15×10^5 maxwells. This current is reduced to zero in 1/10 second by opening a switch, to determine the mean e.m.f. induced in the six coils, and their total inductance.

The number of linkages with each coil $= 15 \times 10^5 \times 800 = 12 \times 10^8$.

The number of linkages with six coils $= 12 \times 10^8 \times 6 = 72 \times 10^8$.

At the end of 1/10 second the linkages is zero; therefore, the mean e.m.f. induced in the six coils is

$$E = 72 \times 10^8 \div 1/10 = 720 \times 10^8 \text{ absolute units.}$$
$$= 720 \text{ volts.}$$

Assuming the permeability of the magnetic circuits to be constant, there would be $72 \times 10^8 \div 8 = 9 \times 10^8$ linkages with unit current in the coils. The inductance of the six coils in series is thus:—

$$L = 9 \times 10^8 \div 10^9 = .9 \text{ henry.}$$

It is usually this inductive e.m.f. which causes the flash when a switch is opened.

Mutual Induction.—Imagine two loops of wire to be placed near to one another as shown in Fig. 30, their axes being coincident. If a current is passed through A, some of the lines of force set up by this current will link with the coil B; and if the permeability of the magnetic circuit is constant, as in the case of air, the flux, and consequently the linkages with coil B, will be proportional to the current in coil A. If Q represents the number of linkages with B, then

$$Q = MI \quad \ldots\ldots\ldots\ldots \quad (14)$$

M being a constant known as the "coefficient of mutual induction," or the "mutual inductance" of the two circuits. If the current in A is varied, there will be a change in the number of lines of force linked with B, and this will induce an e.m.f. in B, the value of which, in absolute units, will be equal to the rate of change of linkages.

Since the coil B might have been selected to pass the current through, it is obvious that the relation of the coil A to the coil B must be the same as the relation of the coil B to the coil A, as stated above. In other words, their relations with respect to inductance are perfectly mutual, and consequently there will be the same number of linkages with A, when unit current is flowing in B, as there are with B when unit current is flowing in A. The mutual inductance of two circuits is, therefore, the number of linkages with either one when unit current is flowing in the other. This number will depend on the proximity and relative position of the circuits. If, for example, A and B consist of a number of loops or turns linked with an iron circuit, as shown in Fig. 31, the value of M will be largely increased, but in this case it will not be constant because of the variations in the magnetic permeability of the iron.

If an alternating current is passed through the coil A (Fig. 31), it is obvious that there will be an alternating flux, and consequently an alternating e.m.f. induced in B. The value of this e.m.f. will depend on the value of M, which can be varied by increasing or decreasing the number of turns on B. It is thus possible to get an e.m.f. induced in B of any desired value. This is the working principle of the static transformer, which will be discussed fully in a later chapter.

The induction of e.m.fs. is one of the most important fundamental physical laws, and is used to advantage in the construction of many modern electrical machines and systems. On the other hand, the inductance of a circuit is a serious obstacle to the satisfactory performance of certain kinds of apparatus under certain conditions. For example, suppose a quantity of power is being transmitted over a line which runs parallel to a telephone circuit. The lines of force set up by the current in the power line will link with the telephone circuit and induce an e.m.f., which will give rise to a buzz in the telephone. If the current in the power line is large and the circuits are close together, the user of the telephone is liable to get a shock unless provision is made to prevent it.

PROGRESS OF TESTS ON THE ACTION OF SEA WATER ON CONCRETE AT THE CHARLESTOWN NAVY YARD.

A rigid inspection has recently been made by engineers of the Navy Department on the specimens of concrete prepared by the Aberthaw Construction Co., Boston, Mass., in January and February, 1909, and immersed in sea water at the Charlestown Navy Yard, Boston, Mass., in the latter part of February and the first part of March, 1909.

In view of the fact that no appreciative change has taken place to date, reliable conclusions cannot yet be drawn from a comparison of the various pieces. The tests will be continued another year before publishing a report.

ROAD MATERIALS AND SOME SIMPLE RULES FOR TESTING THEM.*

By Austin B. Fletcher, M. Am. Soc. C.E.
Secretary Massachusetts Highway Commission

A great diversity of materials enter into the construction of roads of the present day, for in this great country of ours every variety of climatic, geologic and topographic conditions exist. Materials which might be economically useful in one part of the country may not be used elsewhere with economy because of excessive costs of haulage. An inferior material may often be useful economically because of the great cost of securing a superior material, and in general, without reference to city streets which do not come within the purview of this paper, it may be stated that for our common roads we must rely upon materials which are native to our own locality.

This is true when the United States are considered as a whole, and it is equally true when the needs of any single state or locality are investigated. Even in so small a state as Massachusetts, with its area of only 8,200 square miles, it often happens that an inferior local stone must be used because it is better economy to reconstruct or resurface more frequently than to pay the cost of transporting the much superior trap rock and with it resurface less often.

Indeed, it sometimes happens that it is better economy to use a gravel which admittedly requires attention at relatively short intervals of time than to use local stone in the form of macadam. And in some of the middle states and elsewhere it is found that by the skillful use of the log drag, ordinary loam makes a very good road surface during the greater part of the year.

There is, however, an exception to the general statement made above. In many of the states where asphaltic oils are not indigenous it seems possible to produce very fair results by combining such oils with sand and gravel. Reports indicate that much work of this sort has been done in California during a period of some years. By reason principally of the relatively small quantity of the material which is required, it is possible to transport the oil for long distances economically. Massachusetts, geographically, is as unfavorably placed as possible as concerns this material, but the long haul from the middle west or from Texas does not seem to preclude its use.

The writer has tried to make it clear that a general discussion of all of the materials used for road purposes in the United States is difficult, at least from the personal knowledge of an individual, and therefore this paper is limited to such materials as he is familiar with and which are commonly used in Massachusetts. He does not pretend to any acquaintance with gumbo, novaculite, asphaltic rock, etc., etc., which are without doubt very useful materials in the localities where they are found.

The paper may therefore be divided into the following parts:—

1. Sand and Clay.
2. Gravel.
3. Rock Suitable for Macadam Purposes.
4. Bituminous Materials.

In what follows it should be remembered that the writer is discussing materials for use on roads having at least a moderate amount of traffic. Some statements do not apply to by-roads or ways upon which the traffic is small an in general main inter-town roads are referred to.

*Paper read at First American Congress of Road Builders, Seattle, Wash.

Sand and Clay.

With the single exception of ordinary earth or loam, sand and clay in combination is probably the lowest type of material available for road purposes.

Without doubt loam should never be so used, with regard to economy, if anything better is obtainable at a reasonable cost. It is true that by the use of a log drag or road scraper, under the direction of trained operators, loam roads may be kept in excellent condition during the summer months, but in the spring with the frost coming out and the snow melting the condition of such roads is intolerable.

Sand, of itself, while at its best in winter and spring, does not ever have sufficient stability to sustain traffic over it, and clay, of itself, is open to the same or greater objection than loam.

It is possible, however, to combine sand with clay in such a manner than under moderate traffic and favorable climatic conditions a fairly serviceable road may be obtained. But were a gravel even of inferior quality available, a sand-clay road would not be considered seriously.

Gravel

Gravel, unlike sand, loam and clay, is not a simple material. Indeed, it is usually a mixture of materials, small pebbles or stone fragments combined with either sand or clay.

It is very widely distributed throughout the glaciated portion of the country. Professor N. S. Shaler has stated that it rarely occurs that gravel cannot be found within an area of ten miles square in the glaciated field.

But gravel suitable for road purposes is not so plentiful as the foregoing statement would indicate, since unless the pebbles are combined with the sand or with the clay in proper proportions, the gravel, without treatment, may be of little value.

Probably the best gravel is what is called in some parts of New England, "blue gravel." This material is in effect finely broken trap rock which has been subjected to little or no water action. The fragments are angular; the gravel contains little argillaceous matter and when placed on the road and rolled the fragments lock together into a mass having relatively few voids and great stability. The deposits of this blue gravel are rare and the community with a bed of such material is to be congratulated. Its road problem is not a serious one.

As between the sandy gravels and the clayey, the choice should be usually in favor of the former unless the clay is in relatively small proportion. Too much clay makes a muddy road and one which is easily rutted by traffic. Too much sand, with large pebbles makes a mass with little or no stability and no amount of rolling will compact it.

For the best results, in general, considering the ordinary gravels, the writer believes that all stones which will not pass through a two and one-half inch mesh should be screened out; that at least 50 per cent. by weight should consist of pebbles or fragments which will not pass through a one and one-quarter inch mesh; at least 80 per cent. should not pass through a one-half inch mesh; and that the remainder should consist of small fragments of pebbles and sand from less than one-half of an inch in diameter to an inpalpable powder.

The writer admits that such a gravel is too rarely found, but he offers it as an ideal to be approached as nearly as is possible, always bearing in mind the economics of the problem.

A gravel so graded, when properly rolled, has great stability in the road. If the pebbles in the gravels are from rocks of a crystalline or eruptive nature, as is usually the case in New England, a road built of such material will make but little mud under traffic and should not rut to any considerable extent even when the frost is coming out of the ground.

Rocks

In general, the chief desiderata in rocks for road building are hardness and toughness, and the writer believes that toughness should be written first. It is wholly within the range of possibility that in the most modern types of road surfaces, considered economical for the kind of roads herein contemplated, namely, those in which some form of bitumen is used as a binder or matrix, or as a wearing coat, stones of somewhat inferior quality may be used safely.

If the road builder has a choice between stones for macadam purposes, and too often he has not, no scientific instruments of precision are usually required to determine the relative value of the stones. The stone hammer and the scratching of one stone with the other are all that are necessary. And it may also be generally stated that the rocks having a fine texture are more likely to be tough than those having coarse crystals. When there is not an excess of motor vehicles in the locality, a smooth surfaced road will be more often secured if ledge rock is used rather than field boulders. The field stones are usually of glacial origin. The fact that they escaped utter demolition in the cataclysmic grindings of the glacial period indicated that they were of the toughest and hardest parts of the rocks from which they were separated. But while they may be harder and tougher than the ledge rock in the locality, because of lack of uniformity in these characteristics, comparing boulder with boulder, the road surface in which they are placed is likely to wear less smoothly than if ledge rock is used.

Under very light traffic or when motor vehicles predominate, the writer believes that a relatively soft rock will often prove to be more economical than a relatively hard one; also that under such conditions when a good gravel is obtainable, its use will usually prove to be more economical than if the road is built after the macadam type.

Much has been said and written about the cementing power of the fine dust or powder which results from the crushing of stone by machinery. The writer believes that certain stones, notably the limestones, undoubtedly produce screenings of value in this respect. But while most of the other stones make a dust almost wholly lacking in this property, such screening when properly applied serve well as a binder. It would seem that the action is more mechanical than chemical. The fact that sand, if the particles are angular and not rounded, is often used satisfactorily as a binder would seem to prove this hypothesis.

Of the most common stones used for macadam work, it has come to be generally accepted that trap rock (diabases, diorites and some other rocks of an igneous metamorphosis) is the best. In the order of merit there follows the felsites, hornblendic granites, the harder limestones, schists and quartzites. It is not safe, however, without investigation and tests, to say for instance that a granite is always better than a limestone, since some of the non-crystalline limestones are often found to be far superior to the large crystalled granites. This may also be found to be true when other rocks of the foregoing list are compared with one another.

Undoubtedly, the best laboratory tests of rocks for road building are those made by the Office of Public Roads at Washington, D.C., of which Mr. L. W. Page is director.

That department undertakes to make tests and analyses of stones without charge. It has done much excellent work and tests and reports on tests are made with admirable promptness. The nature of the tests as made by the Office of Public Roads will not be discussed here. They include everything hereinbefore referred to concerning tests of rocks and much more, and they have been completely described in the bulletins of that department.

Bituminous Materials

The writer pauses before entering upon the discussion of the tests of bituminous materials which may be used in road work. While there is no doubt that this material is the most interesting that has so far entered into the construction of road surfaces, it is so new that no standards have been fixed.

The necessity for the use of such materials on our rural roads is wholly due to the rapid change in traffic conditions from horse drawn to self-propelled vehicles. Nor is it known precisely why motor vehicles require so different a kind of road surface. Much has been said and written, and the writer of this paper acknowledges his own errors in that particular about the suction caused by the tires of such vehicles. While suction may play some part in the erosion of road surfaces, it is coming to be recognized that the principal source of difficulty lies in the disintegrating action of the rear wheels of motor vehicles. The tractive power being applied through the rear wheels results in a tangential stress upon the surface instead of a pressure normal to the surface, as in the case of the horse-drawn vehicle.

Until comparatively recently it has not been necesary to provide against any such tangential stress, but no macadam road which will receive much motor vehicle traffic could now be planned without taking it into consideration

Thus far bituminous materials, only, seem to offer a remedy for the difficulty at a cost which is reasonable, and the coal tars, asphaltic oils, and asphalts are the materials to which road builders have turned their attention in their search for a binder for the broken stone.

The writer is aware that the title of this paper mentions particularly simple tests. There is no such thing as a simple test of bituminous materials. There is no branch of chemistry which gives the chemist more trouble than the analyzing of materials containing bitumens.

It is true that the coal tars have been used for many years here and abroad for sidewalk purposes and to some extent in roadways, and that some of the men who have handled the materials have become more or less expert in their use. Indeed, some of these men claim to be able to judge of the quality of a tar when heated by watching it drip off the end of a stick or by chewing it. But these tests are rather too crude for the engineer and the expert chewer cannot describe his sensations accurately enough for insertion in specifications. The results secured in the use of tar also indicate that these empiric methods are too crude, since while some of the work done has been excellent, other tar constructions have disintegrated rapidly

All this leads the writer to the belief that the chemist must, in a large measure, work out this new problem for the road builder.

The coal tars have been used sufficiently in the past in road building to indicate that to be of substantial benefit they must be partially refined and possibly combined with other materials. Unless they are treated so that all the water, the naphthas, some of the light oils and the ammoniacal liquors, are removed, they will prove of little value. But just what the permissible specific gravity and percentage of free carbon, and what the viscosity and other characteristics should be, are questions of greater difficulty.

The chemists, acting with the engineers, are working diligently on these questions, and it is hoped that by their combined efforts the essential characteristics will be standardized.

The asphaltic oils likewise promise to be useful as binders for macadam and gravel roads, but even less is known of them than of the tars. It seems to be reasonably safe to say that they should be free from water, and that no oil which has a base of paraffin should be used. The value of the oil should depend on the amount of bitumen contained in it. Oils having a relatively low percentage of bitumen are useful for surface application to alleviate the dust nuisance, but for use as a binder in gravel or macadam work it now seems that those oils which have the greatest percentage of bitumen will prove most economical.

It is an open question whether the best asphaltic oil is such as is made up synthetically by thinning down asphalts with lighter oils or fluxing oils, or whether the best oil is secured by stopping the refining process at just the right point and before the refining is carried to the hard asphalt stage. It would appear that the first process should give a product more uniform than the latter, but which process is the better is not yet determined.

The asphalts which are being experimented with as binders are mostly of those made from asphaltic oils. No one knows whether they will prove more economical for use than the so-called natural asphalts such as the Trinidad or the Bermudez. Lacking the test of time, the oil asphalts appear to be cheaper.

The following specifications will give some idea of the complexity of the artificial binders here under discussion. They are such as have been prepared for the Massachusetts Highway commission by Mr. H. W. Clark, chief chemist of the Massachusetts state Board of Health, and represent the results of a considerable study of the materials in the laboratory and in the roads. It is not claimed that they are in perfect form but the commission is using materials conforming to them this year in its treatment of many miles of road. The specifications are intended to represent what have been so far offered as the best materials for bituminous road binders:—

Refined Tar

Sec. 10a.—The tar must be uniform in color, character, appearance and viscosity and must have the following qualities:—

a.—It shall contain not more than 0.5 per cent. of mineral matter or dirt.

b.—It shall have a specific gravity between 1.18 and 1.25.

c.—It shall not contain more than 14 per cent. by weight of free carbon.

d.—It shall contain no body that distills at a lower temperature than 25° C.; not over ten per cent. by weight shall distill below 270° C. and it shall contain at least 65 per cent. by weight of pitch and bituminous material remaining after all bodies up to 360° C. have been distilled.

e.—When 20 grams are heated in a flat-bottom dish 3 inches in diameter for twenty-one hours in an oven kept at a temperature of 100° C. the loss shall be not more than 10 per cent. by weight.

f.—It shall be of such viscosity that 60 c.c. measured at room temperature (78° F. or 26° C.) shall when at 100° C. be not less than 85 seconds and not more than 240 seconds in passing through a viscosmeter orifice 5-64 of an inch in diameter when acting under a head of 4¼ inches.

g.—When 12½ per cent. by weight of the material is mixed with 87½ per cent. by weight of sand, of such a grade that all will pass through a sieve having 10 meshes to the linear inch and practically none through a sieve having 100 meshes to the linear inch and briquettes made 3 inches square and ½-inch thick, such briquettes will so harden in seven days at ordinary room temperature that when laid flat and held by their edges by two parallel knife-edge bars, they shall not bend when a weight is suspended from a third knife-edge or parallel bar placed across their centre until this weight reaches 200 grams and shall not break at less than 250 grams, and the weight causing bending shall not be greater than 80 per cent. of the weight causing breaking.

Asphaltic Oil

Sec. 10b.—The oil submitted shall be of a uniform color, appearance, general character and viscosity, must contain no bodies not naturally present in an asphaltic oil and must fulfill the following requirements:—

1. It shall not contain more than 0.5 per cent. of dirt or adventitious mineral matter.

2. It shall have a specific gravity of at least 0.97.

3. It shall not contain more than 1 per cent. of matter insoluble in carbon bisulphide and should not contain more than 10.0 per cent. insoluble in petroleum ether.

4. It shall contain no body that distills at a lower temperature than 250° C. and shall not lose more than 55 per cent. by weight by distillation to 360° C.

5. It shall be of such viscosity that 60 c.c. measured at room temperature (78° F. or 26° C.) shall when at 100° C. be not less than 5 minutes nor more than 10 minutes in passing through a viscosimeter orifice 5-64 of an inch in diameter when acting under a head of 4½ inches.

6. When 20 grams are heated in a flat-bottom dish 3 inches in diameter for twenty-one hours in an oven kept at a temperature of 100° C. it shall not lose more than 5 per cent. by weight.

7. When 12½ per cent. by weight of material is mixed with 87½ per cent. by weight of sand and briquettes made 3 inches square and one-half inch thick, these briquettes must keep their shape and show some binding together.

Oil Asphalt

Sec. 10c.—1. The asphalt submitted shall be of uniform color, appearance and character, and shall contain no body not naturally present in an oil asphalt.

2. It shall not contain more than 1 per cent. of dirt or adventitious mineral matter.

3. It shall have a specific gravity between 1.00 and 1.10.

4. It shall not contain more than 1 per cent. of matter insoluble in carbon bisulphide and should not contain more than 30 per cent. insoluble in petroleum ether.

5. It shall contain no body that would distill at a lower temperature than 225° C. and should not lose more than 40 per cent. by weight by distilling to 360° C.

6. When 20 grams are heated in a flat-bottom dish 3 inches in diameter for twenty-one hours in an oven kept at a temperature of 160° C. the weight shall remain practically constant.

Conclusion

The writer is aware that he has failed to include in this paper many tests, simple or otherwise, of a great variety of materials which enter into the construction of a modern road. No mention has been made of tests of cement, steel, clay pipes, paint, etc. To have included them would have made this paper unduly long and would, perhaps, have taken it beyond the scope intended by the committee of the congress which assigned the subject to the writer.

The simplest and best test of road materials is their behavior under actual usage during a term of years. All accelerated tests may lead the investigator into error, but often it is not possible to wait for time to show results.

Such is the case with the use of a bituminous binder which, as has already been stated, is the most interesting subject which the world's road builders have before them at the present time.

Of the three mentioned in this paper, the tars are best known. Some excellent results have been secured by their use, and many failures have occurred. There is no doubt that a specification for the best tar composition will soon be available. As for the asphaltic oils and the oil asphalts, not so much can be said at the present time. They have not fully demonstrated their usefulness, in the Eastern States, at least, and they must be watched for a term of years. They give great promise, however.

It must not be forgotten that it may cost less to resurface a road with an inferior material, often applied, than to use the new materials now entering into rural road construction.

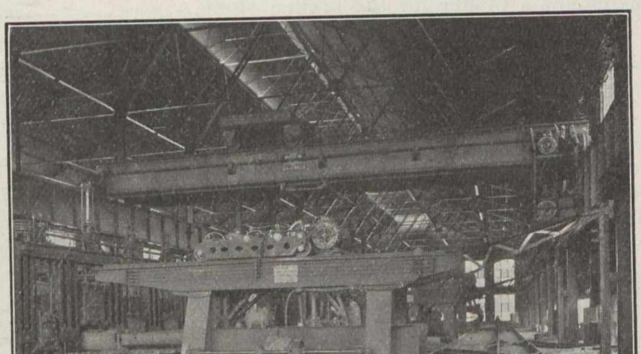
The cost per unit per annum is the ultimate test of the usefulness of any material.

ELECTRIC OPEN-HEARTH CHARGING AT LACKAWANNA STEEL PLANT.

By Frank C. Perkins

The accompanying illustration shows the unique electrical charging machines used at the open-hearth furnace plant of the Lackawanna Steel Company at Buffalo, N.Y. The two electric-driven floor type of open-hearth charging machines seen in the illustration, are equipped with four motors and have a capacity of 10,000 pounds. These charging machines, it will be noted, are operated below a Morgan-Laddle crane of 40 tons capacity.

In order that the cost of charging an open-hearth furnace



may be reduced to a minimum the electric charging machine is now considered a necessity. The electric floor type of open-hearth charging machine allows an overhead crane to travel freely over the machine, but the overhead type has also found great favor as it leaves the floor absolutely free and makes a desirable construction as it is not necessary to make the charging floor capable of handling the heavy machines. Separate electric motors are provided for traveling and withdrawing the charging boxes, turning the same within the open-hearth furnaces in charging, all of the motors being controlled from the traveling cage at the rear of the machine.

PILING AND TRESTLING.*

By F. R. Archibald.

In opening the discussion of the subject to-night, I might say that it was thought advisable to divide it into three parts:—

(1) Piling of various kinds, uses to which it is put, costs, etc.

(2) Deterioration and failure of wooden piles, due to animal agencies and preventive treatments.

(3) Temporary trestling.

The first subject, that of piling, may be divided into several heads:

Kinds of piles, costs, supporting power, arrangement in different structures, etc.

There are four main kinds of piles:—

(1) Wooden.
(2) Sand and concrete.
(3) Combined metal and concrete.
(4) Wholly metal.

Wooden piles are by far the most common and generally the cheapest.

They are made from all kinds of timber.

The character of the soil to a large degree, determines the kind of pile to be used.

In soils that are very soft and continually wet, the ordinary spruce, or hemlock pile gives satisfactory service, as there is no danger of wet rot.

Where piles are alternately wet and dry, white oak and yellow pine give the best results.

In hard compact soil it is generally most advantageous to use piles of hard oak and hard pine.

Specifications as to size, vary, but in general, no pile should have a butt diameter less than 8 inches.

When hammer-driven, the heads are generally protected by iron hoops, on cast-iron caps, and in hard or stony soils the points are protected by iron shoes.

The methods of sinking piles vary according to the different conditions of the soil.

Sinking by means of a hammer is the most common method employed.

In some cases this method cannot be used, either owing to the nature of the soil, as in the case of compact sand, or to the nature of the material composing the pile, as in the case of a timber known as palmetto, which is too soft to withstand the blows of a hammer, but which is used on account of its not being attacked by the teredo.

In the above cases the piles are sunk by means of the water jet.

The cost of piles varies within quite wide limits, according to material, length, and location.

The soft woods which are the most plentiful and most widely distributed, will rarely cost more than 10c. per lineal foot, unless the cost of transportation is high.

Pine piles vary in price from 10c. to 15c. per lineal foot, according to length and location.

Oak piles vary in price from 10c. to 30c. per lineal foot.

The cost of driving piles is also very variable.

Under favorable conditions, the cheapest method is by means of the water jet, the cost in one instance (Chicago shore-protection work), being only 1.9c. per lineal foot for 24-foot piles driven 14 feet in sand.

Driving by hammer costs from 8c. to 35c., or even more, according to the nature of the soil, the compactness of the work, and the price of labor.

The bearing power of piles is variously determined.

In the case where the point of the pile rests on rock or other unyielding stratum, the strength of the pile is approximately the crushing strength of the material.

In other cases, the supporting power, is obtained by reason of the friction of earth on the sides of the pile, and is generally calculated by testing the pile, by the application of a direct pressure.

One simple formula for calculating the bearing power of a pile is that given by the Engineering News:—

$$P = \frac{2\ Wh}{d + 1}$$

P = Safe load in tons.
W = Load applied = weight of hammer.
H = Height of fall of hammer in feet.
D = Penetration under last blow in inches.

By actual tests the supporting power of wooden piles has been found to vary from 5 tons in river mud to over 75 tons in clay and gravel.

Sand and concrete piles are not used to any great extent.

Sand piles are constructed by first driving an ordinary pile then withdrawing it and filling the hole with well compacted layers of sand.

In this way, the neighboring soil is compacted and the sand gives a good deal of supporting power by reason of arch action between the grains.

Sand piles would, of course, be of no use in the case of soils containing springs or where there was any likelihood of running water as the sand must be kept well compacted to be able to withstand any pressure.

Concrete piles are either built after the same manner as sand piles or built in moulds and sunk by means of the water jet.

They are often reinforced and have proved very satisfactory though in most cases, wooden piles are used on account of their comparative cheapness.

There are quite a number of types of combined metal and concrete piles manufactured by different companies.

One illustrative type is the Raymond piles.

The company that manufactures this pile (The Raymond Concrete Pile Company, Chicago), claims that concrete piles in general have several advantages.

Permanence; freedom from rot; over-draining and attacks from boring animals; low ultimate cost; and the fact that the materials used may be found anywhere.

It is claimed also that the great advantage of wood piling,—its low initial cost—is disappearing, owing to the increasing price of timber and decreasing price of other materials.

For its own pile, which consists of a steel shell which is first driven, and then filled with concrete, the company claims superiority which consists in:—

(1) The shell which stays in the ground and which may be inspected before filling.

(2) The bearing value due to large size and tapering shape, the 30-foot pile, being 20 inches in diameter at the top and 8 inches at the point. One Raymond pile is claimed to be equal to three ordinary piles of the same length.

(3) Easiness of reinforcement.

(4) Rapidity of placing. It is claimed that 10 to 40 piles can be placed per day.

(5) The fact that there is no driving on the concrete and consequently no danger of fracture.

*Read before the Nova Scotia Society of Engineers.

The steel shell, which is made up of circular riveted sections of sheet steel, of decreasing diameter down to the boot, which is stamped from solid steel, is driven by a collapsible steel core.

This core is made in three segments forming a tapering core.

The segments are brought together or separated by the action of a series of wedges.

A driving cap of hardwood is attached to the core.

1-3-5 concrete is recommended.

In making foundations of these piles, no excavation, sheet piling, showing or pumping is necessary, and the masonry work is minimized.

These piles cost about $20 each.

Piles made wholly of metal may be divided according to their shapes, into:—

(1) Piles of ordinary shape.
(2) Screw piles.
(3) Disk piles.
(4) Sheet piles.

Metal piles of the ordinary shape are generally of cast iron. They are very little used, and then only when the wooden pile that would be necessary cannot be obtained except at such a price as to make its use prohibitive.

These piles are protected by a wooden cap, while being driven as cast iron is deficient in ability to withstand severe shocks.

Two advantages claimed for these piles are:—

That they are able to resist decay.

That they are more easily driven than wooden piles in stony ground or stiff clay.

Their great disadvantage lies in their inability to resist great transverse shocks which would result from floating ice, etc., and which might also occur in handling them.

Screw piles are made up of a rolled iron shaft 3 inches to 8 inches in diameter, having at the foot one or more turns of a cast-iron screw with blades varying from 1 foot to 3 feet in diameter.

The pile is sunk by being screwed into the ground, either by manual, horse or steam power.

The distance to which it can be sunk is limited by the danger of twisting off the shaft. In soil made up of mixed clay and sand screw piles have been sunk forty feet. They are driven quite rapidly under favorable conditions, in one case being driven 20 feet in two hours, by hand labor in clay and sand.

The average day's work, however, by hand labor, is 4 feet to 8 feet for depths of from 15 to 20 feet.

Disk piles differ from screw piles in having a flat disk attached to the end of the shaft instead of a screw, and in being sunk by means of the water jet.

Screw piles have been but little used in this country. In Europe they are used to quite an extent as foundations for small lighthouses, anchorage for buoys, etc.

Nor have disk piles been very much used in America. One case of their use was at Coney Island as a pier foundation.

The piles used here had a shaft 8½ inches in diameter, made on 12-foot to 20-foot sections, and with a disk 2 feet in diameter and 9 inches thick.

Owing to the great bearing surface of the blades of both screw and disk piles, the supporting power even in soft soils is considerable. Their chief use, however, course in structures subjected to uplifting forces, such as the upward force of waves and tides.

The supporting power of these piles varies from 2 tons per square foot of blade in river mud to 8 tons in sand (as at Coney Island.)

Sheet piling, generally made of steel, is very largely used in excavations for foundations where there is a good deal of water.

When the foundation work has been completed, the piling can be removed and used over again. Sometimes, however, it is left as part of the finished foundation.

There are many patented forms of sheet piling, the main feature in all being a locking joint that can be caulked, and so made watertight.

A very common type used in the United States is the Foirstedt type, made up of angles, Z-bars, and channels rivetted together.

The largest price of sheet piling given by the Engineering News is $1.60 to $1.70 per 100 lbs.

Having decided on the pile to be used in any structure, and knowing its safe bearing power, and the weight to be supported, the number of piles needed may be found.

Piles should not be driven too closely together as they are liable to force each other up. The minimum distance apart is generally 2½ feet to 3 feet.

Especially in compact soils piles should be driven from the centre of the area outward. If driven from the outside inward, there is danger of so compacting the soil at the centre as to make it impossible to drive the piles.

Probably the use of piling is greatest in harbor and river work and in railroad work.

In the latter case its two chief uses are in trestles and in foundations for bridges, piers and abutments in soft soils, or where excavation to a solid bearing stratum would involve extortionate expense.

In the case of trestling, the piles are commonly driven in rows at right angles to the centre line of track.

A cap of timber is drift bolted to these, and either the longitudinal stringers placed directly on it or a framework, or bent of timber of one or more tiers built up to the required height.

In pier and abutment construction, several methods are employed by building them on the piles.

Two of the more common cases are:—

(1) When stone is placed between and above the heads of the piles, which are cut off to the same level, and the structures either of concrete or masonry, built upon this foundation.

(2) When a timber grillage with a floor of thick boards is drift-bolted to the piles, and the masonry or concrete built up on it.

The second method would be used only where the timber would be continually wet.

In other cases the piles are driven in close contact with each other in groups. Cylinders of the required diameter, made up of welted plates are then placed over them and sunk from 3 feet below, the space inside the cylinder is filled with concrete.

The cylinders may be of any required height, and are generally capped with an iron plate.

This style of pier is greatly used in the construction of drawbridges, and in navigable streams where the least contraction of the water-way is necessary.

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

THE PRINCIPLE OF STERILIZATION MAY BE EXTENDED TO TORONTO SEWAGE.

The success of the addition of .33 parts in 1,000,000 of calcium hypochlorite to Toronto city water, the fact of an average bacterial reduction of 77 per cent. per c.c., and the total elimination of all intestinal bacteria have combined to make the M.H.O. of Toronto think.

He is beginning to argue thus: "If an infinitesimal pinch of a germicidal salt will destroy intestinal bacteria after they have entered Lake Ontario water, why not apply the pinch before they so enter, and so keep intestinal bacteria out of Lake Ontario?"

The other day Dr. Charles Sheard announced to the Board of Health that calcium hypochlorite had proved successful as a germicide applied to the city water, and recommended that it also be applied to the sewage effluents which will form the discharge from the new sedimentation tanks.

This enunciation, simple as it may appear, actually constitutes the first stage in the possible adoption of a policy which will ultimately secure to Toronto a water supply untrammeled by insanitary risks. **In fact, the policy of prevention looks like getting a chance at last.**

The "insanitary" condition of Lake Ontario in the the neighborhood of Toronto has been accepted as something practically beyond control. The average number of bacteria in Lake Ontario water beyond the zone of Toronto's sewage contamination amounts to from 8 to 10 per c.c. The average number of bacteria in Lake Ontario water at the water supply intake from April 3rd to April 23rd, this year, amounted to 2,005 per c.c.; while, 44 per cent. of the tests showed the presence of intestinal bacteria.

The policy of extending the intake pipe to a point beyond the present zone of contamination, wherever this may be, although apparently based on requirements of immediate necessity, is based on the principle of fleeing from a present and ever approaching enemy.

The policy of filtering Lake Ontario water is based on the principle that it is impossible to obtain raw pure Lake Ontario water, and that a partial compromise may be effected by the removal of about 98 per cent. of the impurity by artificially treating an impure water.

The policy of building intercepting trunk sewers is based on the principle of removing an acknowledged nuisance from Toronto Bay, and creating a fresh nuisance in a suburban part of the city; by (a) filling up Ashbridge's Bay with putrefying sewage sludge, and (b) turning the raw liquid sewage plus about 40 per cent. of the finer solids direct into the western lake current, by which it may gain ready access to the intake pipe, extended or not extended.

The policy of installing "Dortmund" sedimentation tanks at Morley Avenue, the terminal of the trunk sewer, is based on the principle of removing an aesthetic nuisance only, and does not touch the question of improvement of the sanitary condition of Lake Ontario in the vicinity of Toronto.

The whole sewage disposal policy of the city of Toronto is similar to the policy of the ostrich which on the approach of danger, hides its head in the sand. It (the policy), says, let us remove the grosser solids from the sewage, that which is apparent to the sight; but, the real dangerous elements, the finer solids (not readily apparent), the organic matter in solution, the colloidal matter, and the millions of intestinal bacteria per every ounce of sewage, let them pass into Lake Ontario, and rely either on sand filtration or intake pipe extensions to escape their influence.

No one who has studied the sewage disposal problem will deny but that there is sufficient pure water, charged with oxygen, in Lake Ontario to complete the oxidation of the organic matter accompanying Toronto's sewage. The oxidation of putrescible matter is not, however, the question of moment. The organic matter contained in the sewage of Buffalo is thoroughly oxidized by Niagara Falls and rapids; the water at Niagara-on-the-Lake, however, is bacteriologically as impure as the water above the Falls.

During and after strong easterly winds, the long-shore current will just take the water of Lake Ontario from the point of sewage discharge, and, in about one hour, will dump it in and around the intake pipe, extended or not extended. Bacteriologically, the water around the intake pipe will be almost as impure as the water at the point of sewage discharge.

Dr. Sheard, the Medical Health Officer, knows this. Mr. Rust, the city engineer, knows this. Mr. Fellowes, the water works engineer, knows this. Not one of them can or will deny this apparent and self-evident proposition. But it may be stated by either one or all of them, "We will have the filtration plant working, 98 per cent. (and even at times one better) of the intestinal bacteria will be held back on the surface of the sand filter."

Ninety-eight per cent. removal of bacteria, two out of every hundred only to find their way into the water mains. We do not deny the evident high efficiency of slow sand filtration, or the apparent reduction of disease causation. But, is it not a fact that there are times of short sand circuit and many other factors which cause the lowering of the average efficiency, as witnessed by all such plants, wherever installed?

Where, as in many instances, with rivers, the pollution of which is not subject to control, sand filtration, and even continuous disinfection of a water supply is absolutely necessary.

The question of the conservation, and even redemption of the purity of Lake Ontario water is a practical one. The cause of pollution is within the range of control. Never before, with the concentration of the sewage at one location now made possible by the trunk sewers, has there been offered such an opportunity for the thorough sterilization and destruction of the intestinal bacteria which are the cause of the insanitary condition of the water supply.

We have said that the first step in the possible inauguration of a new policy has been enunciated by Dr. Chas. Sheard. Dr. Sheard has announced his retirement from public service. Let us ask that Dr. Sheard will reconsider his determination, and that the City Council will ensure that the doctor's services are secured to the city, until such time, at least, when his policy will have attained practical fulfilment.

May we sum up again, as we have summed up on this question before. By all means extend the intake pipe as far as possible beyond all wave action and sand banks. Rush the filtration plant to a finish, and ensure water minus turbidity and greatly reduced chance of infection; but, at the same time, let us take all the preventive measures possible to ensure a pure water in the vicinity of Toronto, and a water at any rate devoid of disease germs.

WHO WILL SUCCEED DR. HODGETTS?

The question of a successor to Dr. Hodgetts is not an easy one. Throughout Ontario there are, no doubt, many medical men to choose from, who equally could prove administrative qualities equal to this responsible office.

A Provincial medical officer of health must not only be proficient in medical knowledge, but he must be a first-class business man, capable of organizing and of primary importance he must have **tact.** A knowledge of the people and conditions of Ontario are especially necessary in handling many of the sanitary questions of the day.

It would appear to us that the Hon. the Provincial Secretary might go far and find no better man to succeed Dr. Hodgetts than his able Lieutenant, Dr. R. W. Bell.

Dr. R. W. Bell was lately offered and refused the Assistant Commissionership of Health for the Province of Saskatchewan, choosing rather to remain identified with the Ontario Provincial Board of Health, where he has acted as Dr. Hodgett's assistant for over six years.

Dr. Bell graduated at McGill in 1873. He has the full confidence of Sanitary Engineers and Medical Officers of Health in Ontario. There is hardly a town or village in Ontario that Dr. Bell is not acquainted with, and he has most successfully acted in Dr. Hodgett's place during his frequent periods of absence.

THE DISINFECTION OF TORONTO WATER SUPPLY.

By T. Aird Murray, M. Can. Soc. C.E.

The following data relating to the reduction of total bacteria and the total elimination of intestinal bacteria by the temporary use of hypochlorite as a disinfectant should prove of interest:

Toronto Disinfecting Plant.

April 3rd to April 23rd, 1910.

.33 parts to 1,000,000 Calcium Hypochlorite added.

Date.	Raw Water.	Disinfected.	Reduction.	Percentage Reduction.
April 3rd	1680	450	1230	73.2
" 6th	710	140	570	80.2
" 7th	810	380	430	53.0
" 8th	280	180	100	35.6
" 9th	4120	980	3140	76.2
" 10th	1425	380	1045	73.3
" 11th	290	60	230	79.3
" 13th	3310	70	3240	97.9
" 14th	150	40	110	73.3
" 15th	2670	960	1710	64.0
" 16th	1210	50	1160	95.9
" 17th	460	170	290	63.0
" 18th	9270	1890	7380	79.6
" 20th	3520	1420	2100	59.6
" 22nd	280	100	180	64.3
" 23rd	1890	80	1810	90.4
Average	2005	458	1545	77%

Tests are per cubic centimeter.

Toronto Disinfecting Plant.

April 3rd to April 23rd, 1910.

.33 parts of 1,000,000 of Calcium Hypochlorite added.

	Samples.	B. coli absent.	B. coli present.
Raw Water	16	9	7
Disinfected Water	16	16	0

Percentage positive tests for "B. Coli" in C.C. of raw water for 16 tests, 44 per cent.

Percentage positive tests for "B. Coli" in C.C. of disinfected water, 0. per cent.

Toronto, on the advice of the writer, resolved in the latter end of March to apply small quantities of calcium hypochlorite to the city water supply.

The months of February and March were accompanied by a high and increasing typhoid rate, while the water was stated by the City Medical Department to be very bad, and all users were recommended to boil the water.

The greater part of Toronto sewage discharges untreated into the bay which is divided from the lake by a long sandbar forming an island. At the east and west ends of the island there are channels cut allowing entrance to the bay. The water supply is obtained not from the bay, but from a point in the lake south of the island.

Strong currents alternate from the east and west entrances between the bay and the lake depending on wind direction. Consequently much of the polluted bay water flows into the lake proper and works its way around the island to the vicinity of the water intake.

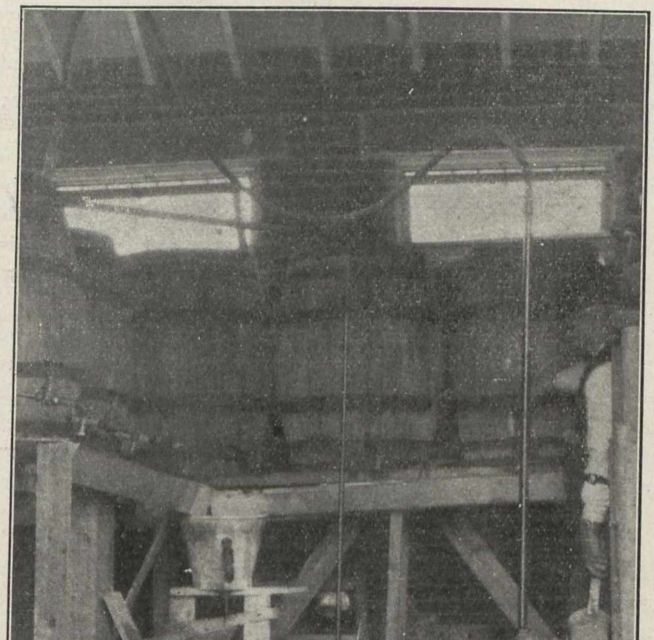
In the winter time the whole of the bay is frozen over, oxidation of the bay water is reduced, and consequently a greater degree of pollution of the lake water makes itself evident. Especially is the increase in pollution made evident on the breaking up of the bay ice, which is used for several months as a highway between the island and mainland. It is also apparent that large quantities of raw sewage must be retained "in cold storage" in the ice during the winter months, only to be released in bulk in the spring of the year.

The intake pipe is carried out into the lake to a depth of 75 feet, and of late it has been found that a sand bank has formed around the base of the intake 25 feet in height, reaching almost to the turned-up intake influent, which is about 50 feet below the lake surface.

Beyond the influence of wave action and contaminating influences of Toronto sewage, Lake Ontario presents a water of a very high purity standard. It is, in fact, both chemically and bacteriologically pure, with a hardness represented by only about 7 degrees.

It is a well-known fact that storage of water tends to reduce the number of bacteria, and we have a good example of this in the lake. The line dividing the zone of turbidity from the blue, clear water is at times distinctly marked, and a sample of water may be taken at one side of a boat containing any number of bacteria below 100 per c.c., while on the other side within the yellow or turbid water a sample may show over 5,000 bacteria per c.c.

The dividing line between turbid and clear water is ever shifting, depending on strength and direction of winds, while there is practically no constant current in any one direction. The strongest currents are, however, from the east, owing to a greater stretch of water surface exposed in this direction to the full force of the wind. In fact, the island has been built up by the action of this current carrying sand from Scarboro Bluffs about five miles to the east.



A Primitive Plant for treating water by Hypo-Chlorite.

The table of the numbers of bacteria in the raw water shows great variation, 150 per c.c. being the lowest count, while 9,270 is the highest. The variations are entirely due to wind and consequent increase or decrease in turbidity.

The almost daily samples which were taken both of the raw and disinfected water were for the purpose of determining the advisability of continuing the use of the disinfectant. The results have so far justified the continuation of the treatment.

The apparatus for applying the disinfectant is of a primitive and temporary character. It consists, as the photograph shows, of ordinary barrels mounted on staging. The chloride of lime is mixed in the barrels by hand, and after the calcium hydrate has settled, the liquid flows into a receiving trough, and then into an ordinary metal pail with an overflow fixed to provide the constant head at the outlet orifice to measure the amount required at the rate of .33 parts per 1,000,000 of available chloride.

The whole plant has not cost $100, while the cost of disinfection and operating amounts to 52 cents per 1,000,000 gallons. Thus 35,000,000 gallons of water are treated per day at a cost of $18.20, and this figure has of late been reduced somewhat.

An interesting feature of this temporary plant lies in the fact that we are treating a raw, unfiltered water with a very small amount of chlorine, and yet good results are obtained. It is generally acknowledged that all methods of disinifection relying on nascent oxygen as the germicide, provide efficiencies in proportion to the amount of chemical used, depending on the previous successful removal of suspended organic matter. With Lake Ontario water, even under conditions of turbidity, the organic suspended matter is low. The suspended matter for the most part consists of almost ultra microscopic sand particles which only settle out slowly by sedimentation, turbidity lasting for several days after a lake wind storm.

It is, therefore, apparent that we have a water which is peculiarly adapted to direct sterilization; although, of course, it is undoubted but that much higher germicidal efficiencies would be obtained if the water was first filtered, even with roughing filters. Apart from occasional turbidity, color is practically nil.

Since the introduction of the disinfectant, there has been a diminution of the typhoid rate equivalent to the reduction of bacteria. For instance, the typhoid rate for the two months following disinfection shows a reduction of 78 per cent. from the two months previous to disinfection, while the average bacteria reduction by disinfection has been 77 per cent. How far this is due to coincidence it is impossible to say, as apart from disinfection, it was to be expected that the typhoid rate would show a decrease with improved weather conditions.

At the present time Canada has in hand the installation of an up-to-date slow sand filtration plant. This, however, will not be complete until some time in the fall of next year. Further, the prevention of the pollution of the bay is being undertaken by the construction of trunk intercepting sewers which will concentrate the sewage at one point about 2½ miles east of the intake pipe. In the meantime it is satisfactory to know that we have means at hand for very simply reducing the total number of bacteria, and the total elimination of intestinal bacteria.

It is interesting also to know that the small amount of chlorine added to the water can have no possible effect apart from its germicidal action, and even if the calcium hydrate were also dumped into the water it would only add 1 part per 1,000,000, whereas there are 20 parts of lime normally in the untreated water.

The small amount of hydrochloric acid formed by the combination of the chlorine with the hydrogen in the water does not even chemically amount to a trace, and diluted over 3,000,000 times loses all possible effect.

From a statement recently made by the Medical Health Officer it is very probable that Toronto will add disinfection to the new sewage disposal plant, and that the settled sewage liquid will be so treated before discharging it into the lake.

The following paragraph is culled from our English contemporary, the "Surveyor and Municipal and County Engineer." Is it astonishing that we have young English engineers writing for positions in Canada with home salary inducments at $1.00 per day?

"Willing to Oblige.—An offer by the Ruthin Rural District Council of the munificent salary of £80 ($400.00) a year, including expenses, for the post of surveyor and sanitary inspector, the successful candidate to devote the whole of his time to the duties of the office, elicited a delightful letter of application, which (says the Yorkshire Evening Post) was read to the amused councillors. Writing from Municipal Buildings, "Scandal," an applicant named "A. Catch," said he was tall and good-looking, able to speak eight languages, and was at present learning others. In addition to carrying out the ordinary duties mentioned in the advertisement, he was willing without extra remuneration to act as police-constable, as caretaker of the municipal buildings, as fireman, assist at the cleaning of streets, and the collection of house refuse. The writer said it appeared that there was need to provide a future home for the beneficial treatment of maniacs in the district, and should the soil be clayey he would make brick in his spare time for the building of the "home," and he would even clean the councillors' boots with "Nugget" bought with a portion of the lavish salary offered. He had spent £600 ($3,000) to qualify as a sanitary engineer, but he thought the post such a unique one that it would give him ample scope to complete his education in municipal work. The applicant concluded by asking permission to keep fowls and a cow, in order to provide the poor of the district with eggs and milk free."

DRAINAGE.*

By A. S. Code, O.L.S., Alvinston, Ont.

The subject of drainage is so largely governed by precedent that although new cases are constantly coming up and drainage is the subject of much litigation, I feel that to add to what has appeared in the papers already read before this Association is a difficult matter.

Drainage is in a state of evolution, as it were, and difficulties are constantly appearing that will tax the ingenuities of engineers for some time.

Cases where, by following a natural watercourse, the fall has been so diminished that a straight drain in a new direction would give better drainage are appearing.

Drains that once gave efficient drainage have been found to be now too small owing to better drainage and consequent increased flow from lands above as cultivation is increased.

The conditions of the soil in the matter of percolation is important, and the gauging of size and capacity often depends on this to a considerable extent. Some soils require considerable under-drainage, others often little more than open drains.

There are many creeks that have been rendered insufficient (owing to increased drainage from lands above) that are being straightened and deepened in order to give good outlet.

It is always advisable in laying out drains to provide plenty of depth, as drains which are deep and narrow are much more easily maintained than those having a broad and flat section. Long stretches of even grades should be sought in order to avoid trouble from flooding.

It is well to observe the sectional area of drains and the area drained, and after having considered the fall, a table which may be of considerable use can be formed. A table thus made will compare very favorably with any formula yet devised.

The placing of earth well back from the sides of drains so as to reduce pressure and provide for future enlargement is advisable, and through the cleared lands it should be spread back from the drain.

A great deal of trouble is caused and the cost of maintenance increased by drains not being completed in accordance with the profile, and it is advisable that the engineer should at least make the final inspection, even if he is not asked to make the progress estimates. The specification should be broad and enforced generally.

It is a matter of regret that witnesses at appeals to Courts of Revision are not receiving better remuneration. At present the Division Court tariff is used, ranging from 75 cents per day if the witness lives within the county and within three miles of the place of trial, to $1.25 for witnesses without the county and more than three miles from the place of trial. For barristers and solicitors, physicians and surgeons, engineers and veterinary surgeons, the handsome sum of four dollars is allowed. There is a splendid opportunity here for some "law reform."

The question of assessment is defined as a question of benefit, but the classification of outlet liability and of injuring liability is but little less obscure in many cases. The benefit must be direct, or by cutting off waters from lands, or by a relief from liability for injury, or there must be an improved outlet provided.

It is well in making assessments to outline in general the sum total of the different classes of the assessments under the three headings, and then proceed to calculate the several assessments to be placed upon the several parcels of land. In this way an assessment may be well defended in the courts, and if it proves to be in error the correction is a simple matter.

Examination of the lands is necessary, with care, in cases where an assessment for injuring liability is to be made, and sectional measurements and locations of artificial work is convenient when evidence is to be given.

The cases where an assessment for outlet liability can be made are, first, where at a lower level a drain exists and the municipality constructing a new drain under the Drainage Act uses the lower drain as an outlet for the waters drained from the upper lands to save the cost of further outlet work, and secondly and conversely, where the work is to be constructed on the lower level and it is necessary for the drainage of these lands by reason of water brought down from the upper lands, by artificial means or through a natural water course.

In the matter of descriptions there should be a clear definition even if metes and bounds are necessary, but there are many cases where the assessment roll will not give the necessary information.

*Read before the Ontario Land Surveyors.

ENGINEER'S LIBRARY

BOOK REVIEWS.

Books reviewed in these columns may be secured from the Book Department. Canadian Engineer, 62 Church Street, Toronto.

The Gas, Petrol, and Oil Engine, by Dugald Clerk, F.R.S., M. Inst. C.E. Cloth, vii. + 380 pp., 6 x 9 ins., $5.25 net, London, Longmans, Green and Co., 1909.

This book is a revised and rewritten edition of a previous work entitled "The Gas Engine," published in 1886 and 1896. It deals only with the science of the subject and will be followed by a second volume on practice.

A few figures gleaned from the valuable Historical Sketch with which the volume is prefaced, may bear repetition to indicate the importance of the subject dealt with. The aggregate horse-power of large gas engines (500 to 4,400 h.p.) has reached a total of 575,000 h.p. in Europe and 350,000 h.p. in America. Over 2,000,000 h.p. of smaller gas engines are at work in the world, and certainly over 1,000,000 h.p. of petrol motors. The author closes his historical sketch with a prediction that the interval combustion motor will soon appear as a competitor on sea as vigorously as on land with even the latest form of the steam engine—the steam turbine.

The work itself is a valuable contribution to the technical literature on the subject. The gas engine method and classification of gas engines are taken up in the first two chapters, the third is devoted to Thermodynamics. A short chapter on Causes of Loss in Gas Engines is followed by a lengthy treatment of Combustion and Explosion and Cooling as well as Explosion in a Closed Vessel.

The results of the experiments made recently by workers in America as well as in Europe, are well handled, and the aim of the author to systematize existing knowledge of the working fluid can fairly be said to have been accomplished.

Several appendices have been added dealing with properties of gaseous explosions. The 1908-4 Report of the British Association Committee on Gaseous Explosions, is printed in full. Wm. Snaith.

Engineering Workshop Machines and Processes. Translated from the German of F. Zur-Nedden, by John A. Davenport, M. Sc. Cloth, xv. + 216 pp., 6 x 9 ins., $1.75, London, Constable and Company, Limited, 1910.

The subtitle of this book explains its purpose as a "hand book for the use of students and others taking the workshop training recommended by the Institution of Civil Engineers"; but as outlining a general course in the study of the materials and processes in the manufacture of metal and machinery it will prove of interest and value to those in charge of students in applied science. An appendix contains a report on the education and training of engineers adopted by the Council of the Institution of Civil Engineers. This should prove of timely interest in view of the recent appointment by the Federal Government of a Commission on Technical Education.

Necessarily, the size of the book has prevented any detailed description of tools or processes. Everything taken up is handled in a general way. The translator explains the object of the book as being to supply the engineer seeking shop experience with that elementary knowledge which is so familiar to those around him as to call for no explanation. The work should serve as an introduction to the practice in the foundry, smithy and machine shop; and will prove valuable as a guide to further study.

The chapter devoted to a description of a "Modern Engineering Works" is not a part of the original and suffers by comparison. There is no evidence of design and arrangement in the illustration chosen, the space marked off for future extension having no relation to the existing plant except being in the same neighborhood.

There are many suggestions, however, throughout the work that will guide the observation of the student and aid in the cultivation of the engineering instinct. It can hardly fail to prove of value to those for whom it was written.

Wm. Snaith.

The Twentieth Century Hand Book, by Calvin F. Swingle, published by F. J. Drake & Co., Chicago, size 5 x 6, pp. 1500. This is a practical treatise on the care and management of steam engines, boilers and electrical machinery. It contains in addition, full instructions in regard to the management of all classes of steam engines, steam turbines, gas engines, air compressors and electric and hydraulic elevators.

In the compilation of this section of electricity, special efforts have been put forth to adapt the discussion of this important subject to the needs of the engineer and the electrician in charge of central stations. At the conclusion of each paragraph there are asked and answered a series of questions which the reader may use as a quiz to impress what he has read. The chapters are as follows:—

Boilers, chimneys, heat, steam, valves and setting, tests, indicators, turbines, gas engines, air compressors, ice machines, refrigerators, elevators and electrical apparatus. It will be found a very convenient hand book for the practical man.

A Study in Heat Transmission by J. K. Clement and C. M. Garland, is issued as Bulletin No. 40 of the Engineering Experiment Station of the University of Illinois. The bulletin describes a method of studying the effect of the agitation of a medium in contact with metal walls upon the heat conducted through these walls and to or from the medium. Results of experiments upon the heat transmitted to water as the medium in contact with the walls of a tube, under varying velocities or rates of agitation, are given.

Copies of Bulletin No. 40 may be obtained gratis on application to W. F. M. Goss, director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

The Weathering of Coal, by S. W. Parr and W. F. Wheeler, is issued by the Engineering Experiment Station of the University of Illinois as Bulletin No. 38. This bulletin embodies the results of weathering tests conducted on car-load lots of coal for a period of one year, in the course of which, coal from various mines was exposed in covered bins, open bins and under water. The results are presented in the form of charts which show graphically the losses in heating value resulting from each condition of exposure.

Copies of Bulletin No. 38 may be obtained gratis on application to W. F. M. Goss, director of the Engineering Experiment Station, University of Illinois, Urbana, Illinois.

Cost Data, and hand book for contractors and engineers, by H. P. Gilette, managing editor, Engineering-Contracting, size 5 x 7, pp. 1900, illustrated, price $5.00. This is the second edition of Mr. Gillette's hand book on Cost Data, and contains about four times the information of his first edition.

The list of subjects covered are so numerous and so varied that it seems impossible to here enumerate them, but it is safe to say that on any question the engineer requires information as to costs, it may be found in this book. Not only does it include costs, but in many sections it gives suggestions as to method and also includes some of the simpler empirical formulae.

It is a book that will be welcomed by every engineer and contractor, but it is not to be supposed that the author intends prices given to be the actual cost of work the engineer has estimated upon. It is rather to be used as a guide in preparing estimates, a suggestion as to what is to be covered; an outline of the different items not to be overlooked in estimating. It gives many paragraphs; not only has the author given prices, but he has given that which is frequently of more value, quantities. The sections covered are principles of engineering economics and cost keeping, earth excavation, rock excavation, quarry crushing, roads pavement and rocks, stone masonry, concrete and reinforced concrete construction, waterworks, sewers, timber work, building and railways, bridges and culverts, steel and iron construction, engineering and surveys, miscellaneous and cost data

In addition to a complete table of contents, the volume has in a number of cases cross references.

Metal Spinning, by C. Tuells, published by The Industrial Press, 49 Lafayette St., New York. Size 6 x 9, price 25 cents, pp. 40. This pamphlet, No. 57, will be of unusual interest to metal workers and manufacturers generally.

Metal spinning is an art that was practically perfected long before press working of metals acquired commercial importance. As press working developed, metal spinning declined relatively as a manufacturing method, being essentially a process requiring much manual dexterity and skill. It was never superseded, however, for making silver, brass, copper and aluminum ornamental hollowware.

It is now being revived in modern lines for other than ornamental work, because ties are expensive and there is a constant danger of breakage, and further, because styles and designs are constantly changing, necessitating new ties. This booklet, in addition to a chapter on principles of metal spinning, contains some fifteen pages on the tools and methods used in spinning. It is a very practical treatise.

A Concise Treatise on Reinforced Concrete, by Chas. F. Marsh. By Constable & Co., London. 225 pages. Price, 7s. 6d. net.

This book deals with the subject in a much more concise form than the other book written on the same subject by this author, and with which most engineers engaged in this class of work are familiar.

The first portion of the book deals with the physical properties of reinforced concrete, in which the engineer is interested. This end is fully treated.

Results of tests showing the behavior of concrete structures, such as posts, slabs, beams, and arches are given, as are also conclusions of a practical value which might be drawn from these results.

The chapter on the behavior of the material is followed by chapters dealing with assumptions to be made and formula to be used in the design of structures of different types. Over one-half of the book is devoted to methods of calculation. The design of the reinforced arch is more fully treated in this book than in any other publication of the size with which the writer is familiar.

There are only a few pages devoted to the practical design of structures, the formula being general, it being left to the engineer to make same apply to special cases.

In general, the book deals with the theory of the subject very fully, and to those engaged in arch design, especially is the book recommended. The practical side of the subject is only touched on.

F. A. G.

Electricity, by H. M. Hobart, B.Sc., M. Inst. C. E. Published by Constable and Company, Ltd., London, and the Copp, Clark Co., Ltd., Toronto. 226 pages, 115 illustrations, 43 tables. Price, $1.80 net.

The usual introductory chapters on friction machines, static electricity, etc., found in most text-books on the subject, which are interesting from an historical standpoint, but of little importance to the study of electrical engineering, have been eliminated. A new plan has been adopted which takes the subject up in a more matter-of-fact way. The first two chapters deal principally with the phenomena attending the transmission of electricity through conductors, discussing their characteristics.

Chapters three, four and five discuss energy, its measurements, and the derivation of units, introducing a new name for the unit of electrical energy. Continuous currents and ohms law are fully discussed under chapter six. Chapters seven and eight discuss the magnetic field and its relation to electric currents, and the generation of electrical pressure by a moving conductor in a magnetic field.

Alternating currents and its characteristics, inductance and the magnetic circuit are discussed in chapters nine, ten and eleven; chapter twelve contains a good discussion on the properties of insulation with data.

The greater part of the book is fairly elementary, although certain sections of the book will be found difficult to digest without outside assistance. The book is well written and contains much interesting technical data of use to electrical engineers. It will prove of valuable assistance to the student in acquiring a fundamental knowledge of the subject of electricity. It has been assumed that the reader is possessed of a certain general familiarity with electricity.

F. A. G.

The Design of the Condensing Plant, by F. W. Wright. Published by The Technical Publishing Co., Ltd., London, W.C. 200 pages, 96 illustrations. Price. 3s. 6d. net.

This is one of the very few books devoted exclusively to the consideration of the problems involved in the design and installation of the condensing plant. The problems of the transference of heat from steam to water and the apparatus used for the purpose, and the possibilities of water cooling for continuous use by reservoir and cooling towers are ably discussed. Mechanical details of construction have been secondary and only used to assist in describing the several types of condensers, pumps, cooling towers, etc. The book will be found of considerable interest and help to designing engineers and those connected with the installation of modern steam power plants.

The introduction contains a brief history of the evolution of the steam condenser, followed by a chapter on heat units. Chapters are devoted to the jet, ejector, and surface condensers, in which their design, use and characteristics are fully described with numerous cuts and illustrations taken from practice.

The design of the jet and surface condenser is taken up in detail, discussing the formulæ in general use and the available papers and data on condensation or subjects relating thereto. The author makes use of charts and diagrams to simplify and reduce the labor of calculations. A considerable amount of data has been collected on the condensation of steam from numerous sources, for which full reference is given.

A chapter is devoted to the design and characteristics of the evaporative condenser, followed by one on the water cooling plant, discussing the design of cooling towers. Air pump efficiencies are discussed, and the appendix contains descriptions of the installation of several modern condensing plants.

F. A. G.

Gas, Gasoline and Oil-Engines, including Producer—Gas plants, by Gardner D. Hiscox, M.E., author of "Mechanical Movements," "Compressed Air," etc. Published by the Norman W. Henley Publishing Co., 132 Nassau St., New York. Price, $2.50 net.

This is the seventeenth revised edition of this work and has been brought strictly up to date (1910). So great have been the advances in the gas and oil engine trade of recent date that authors of books covering these lines have found it necessary to revise frequently in order to make them of most value. This book incorporates the very latest practice in this form of motive power, and for this reason will be found valuable. The author's name is familiar to a great many in view of the other works published by him on mechanical subjects, as well as previous editions of the above work. Readers may therefore accept this book with a fair degree of assurity as to its thoroughness and comprehensiveness. To those who have not read previous editions of this same work, several features as to the treatment of the subject will be found of interest. In the first place, the book covers the gas, gasoline, kerosene and crude oil engine, in addition to producer gas plants, showing its comprehensiveness. It will be found specially useful to intending purchasers or those interested in the installation, operation and maintenance of this class of engine. It has been prepared, however, for those engaged in every branch of the trade, as each branch of the subject has been covered at such length as its importance entitles it to. The work is well illustrated, containing over four hundred engravings. A special feature, worthy of note, is a complete list of United States patents issued, covering the gas engine industry up to date. This feature should be of special interest to manufacturers and those in the experimental field. The following features are also deserving of a special mention: The treatment of the theory of Gas, Gasoline and Oil Engines as designed and manufactured in the United States. Explosive motors for stationary, marine and vehicle power are treated at length, together with illustrations of their parts and tabulated sizes, also their care and running are included. Electric Ignition by Induction Coil and Jump Sparks are fully explained and illustrated, including valuable information on the testing for economy and power and the erection of power plants.

The special information on producer and suction gases included cannot fail to prove of value to all interested in the generation of producer gas and its utilization in gas engines.

The rules and regulations of the Board of Fire Underwriters in regard to the installation and management of gasoline motors is given in full, suggesting the safe installation of explosive motor power. A list of the leading gas and oil engine manufacturers in the United States and Canada, with their addresses, is included.

The subject is covered in a most complete manner, as may be seen from the following contents: Theory of the Gas and Gasoline Engine. The Utilization of Heat and Its Efficiency in Explosive Motors. Retarded Combustion, Wall-Cooling, and Compression Efficiencies. Compression in Explosive Motors, and Its Work. Causes of Loss and Inefficiency in Explosive Motors. Economy of the Gas Engine for Electric Lighting, etc., etc. The Material Power in Explosive Engines. Carburetters. Cylinder Capacity of Gas and Gasoline Engines. Governors and Valve Gear. Explosive Motor Ignition. Cylinder Lubricators and Mufflers. Construction Details and Parts of the Explosive Motor. Explosive Motor Dimensions. Types and Details of the Explosive Motor. The Measurement of Power. Management of Explosive Motors. Explosive Engine Testing. The Amateur's Motor. Marine Motors. Motor Bicycle, Tricycles and Automobiles. Kerosene Distilling and Petroleum Oil Motors. Producer Gas and Its Production. At $2.50 this book is available at a popular price.

A. E. U.

PUBLICATIONS RECEIVED.

State Commission of Highways, Report for State of New York, issued by the Commission, of which S. Percy Hooker, is Chairman, Albany, N.Y. Size 6 x 9, pages 500.

Technical Dictionary, volume seven, Hoisting and Conveying Machinery, in six languages. Deinhardt-Schlomann series, compiled by Paul Stulpnagel, published by Constable & Co. Ltd., London, (10 Orange Street, Leicester Sq. W.C.) The Copp Clark Co. Ltd., Toronto. Size 4 x 6, pages 650, price $2.50, net.

Technical Dictionary, volume eight. Reinforced Concrete in Sub. and Superstructure, in six languages. Deinhardt-Schlomann series, compiled by Heinrich Becher, published by Constable & Co. Ltd., London, (10 Orange Street, Leicester Sq., W.C.) The Copp, Clark Co., Limited, Toronto. Size 4 x 6, pages 415, price $1.50.

Technical Dictionary, volume six. Railway Rolling Stock, in six languages. Deinhardt-Schlomann series, compiled by August Boshart. Published by Constable & Co., Ltd., London, (10 Orange Street, Leicester Sq., W.C.) The Copp, Clark Co., Limited, Toronto. Size 4 x 6, pages 800, price $2.50, net.

Tables and Diagrams, for obtaining the Resisting Moments of Eccentric Riveted Connections. By E. A. Rexford, Published by Engineering News Publishing Company, 220 Broadway, New York. Size 7 x 9, pages 70, price $1.00.

Department of Interior, report of the Chief Astronomer for 1908, size 6 x 9, pages 280. W. F. King, Chief Astronomer and Boundary Commissioner, Ottawa, Ont.

Roads Division of the Department of Public Works and Mines, annual report for the year 1909, by Hiram Donkin, C.E., Road Commissioner, Province of Nova Scotia.

Bureau of Labour, tenth report of the Province of Ontario, for the year 1909. By J. C. Reaume, Minister of Public Works, Toronto, Ont., size 6 x 9, pages 280.

Engineering Workshop Machines and Processes, by Dipl-ling F. Zur Needen, translated and revised by John A. Davenport, M.Sc., with an introduction by Sir Alex. B. W. Kennedy, L.L.D. Size 6 x 9, pages 220, price $1.75. Published by Constable & Co. Ltd., London, England.

Concrete-Steel Construction, by Prof. Emil Morsch, size 6 x 9, pages 370, price $5.00. Published by The Engineering News Publishing Co., New York, N.Y.

A Study of Base and Bearing Plates for Columns and Beams, Bulletin No. 35, by Clifford Ricker. Published by University of Illinois Engineering Experiment Station, Urbana, Ill. Size 6 x 9, pages 36.

Logarithmic Slide Rule, by F. Cajori, Ph. D. Published by The Engineering News Publishing Co., New York, size 5 x 7, pages 140, price $1.00.

Reinforced Concrete, by Frederick Rings, Consulting Engineer. Published by B. T. Batsford, 94 High Horborn, London, Eng. Size 5 x 8, pages 200, price $2.00.

Setting the Valves of Canadian-Made Engines, by G. C. Keith, B.Sc. Published by The Maclean Publishing Co., Toronto. Size 7 x 9, pages 32, price 50 cents.

Corrosion and Preservation of Iron and Steel, by Allerton S. Cushman, A.M., Ph.D. (Harvard). Published by the McGraw-Hill Book Co., 239 West 39th St., New York. Size 6 x 9, pages 370, price $4.00.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, Col. H. N. Ruttan; Secretary, Professor C. H. McLeod.

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, A. W. Campbell; Secretary, P. Gillespie, Engineering Building, Toronto University, Toronto. Meets last Thursday of the month.

MANITOBA BRANCH—
Chairman, J. E. Schwitzer; 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

OTTAWA BRANCH—
Chairman, W. J. Stewart, Ottawa; S. J. Chapleau, Resident Engineer's Office, Department of Public Works.

MUNICIPAL ASSOCIATIONS.

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

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UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

CANADIAN TECHNICAL SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, E. C. Hopkins, Edmonton; Secretary, H. M. Widdington, Strathcona, Alberta.

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

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

CANADIAN ASSOCIATION OF STATIONARY ENGINEERS.—President, Charles Kelly, 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, R. E. W. Hagarty, 662 Euclid Ave., Toronto.

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

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

CANADIAN FORESTRY ASSOCIATION.—President, Thomas Southworth, Toronto; Secretary, James Lawler, 11 Queen's Park, Toronto.

CANADIAN MINING INSTITUTE.—Windsor Hotel, Montreal. President, Dr. Frank D. Adams, McGill University, Montreal; 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, J. Duguid; Secretary, C. L. Worth, 409 Union Station. Meets third Tuesday each month except June, July, August.

DOMINION LAND SURVEYORS.—President, Thos. Fawcett, Niagara Falls; Secretary-Treasurer, A. W. Ashton, Ottawa.

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

ENGINEERING SOCIETY, TORONTO UNIVERSITY.—President, A. D. Campbell; Corresponding Secretary, A. H. Munroe.

ENGINEER'S CLUB OF TORONTO.—96 King Street West. President, C. M. Canniff; Secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

INSTITUTION OF ELECTRICAL ENGINEERS.—President, Dr. G. Kapp; Secretary, P. F. Rowell, 92 Victoria Street, London, S.W.; Hon. Secretary-Treasurer for Canada, Lawford Grant, Power Building, Montreal, Que.

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

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

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

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, S. Fenn; Secretary, J. Lorne Allan, 15 Victoria Road, 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, H. W. Selby; Secretary, Killaly Gamble, 703 Temple Building, Toronto.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—President, F. S. Baker, F.R.I.B.A., Toronto, Ont.; Hon. Secretary, Alcide Chausse, No. 5 Beaver Hall Square, Montreal, Que.

ROYAL ASTRONOMICAL SOCIETY.—President, Prof. Alfred T. de Lury, Toronto; Secretary, J. R. Collins, Toronto.

UNDERGRADUATE SOCIETY OF APPLIED SCIENCE, McGILL UNIVERSITY.—President, H. P. Ray; Secretary, J. P. McRae.

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.

AMERICAN TECHNICAL SOCIETIES.

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

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

AMERICAN RAILWAY ENGINEERING AND MAINTENANCE OF WAY ASSOCIATION.—President, L. C. Fritch, Chief Engineer, Chicago G. W. Railway; 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 ENGINEERING-CONTRACTORS.—President, George W. Jackson, contractor, Chicago; Secretary, Daniel J. Hauer, Park Row Building, New York.

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

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

COMING MEETINGS.

CANADIAN ELECTRICAL ASSOCIATION.—July 6-7-8. Annual convention at Royal Muskoka Hotel, Muskoka Lakes, Ont. Secretary, T. S. Young, Confederation Life Building, Toronto, Ont.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION.—June 23-25. Annual meeting at Madison, Wis. Secretary, Henry H. Norris, Cornell University, Ithaca, N.Y.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS.—June 27-30. Annual convention at Jefferson, N.H. Secretary, R. W. Pope, 33 West 39th St., New York City.

AMERICAN SOCIETY FOR TESTING MATERIALS.—June 28-July 2. Annual meeting at Atlantic City, N.J. Secretary, Edgar Marburg, University of Pennsylvania, Philadelphia, Pa.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—August 24-27. Annual meeting at Winnipeg, Man. Alcide Chausse, Hon. Secretary, 5 Beaver Hall Square, Montreal, Que.

AMERICAN RAILWAY MASTER MECHANICS' ASSOCIATION.—June 20-22. Annual convention at Atlantic City, N.J. Secretary, Jos. W. Taylor, 390 Old Colony Bldg., Chicago, Ill.

AMERICAN SOCIETY OF CIVIL ENGINEERS.—June 21-24. Annual convention at Chicago, Ill. Secretary, Chas. W. Hunt, 220 West 57th St., New York City.

AMERICAN INSTITUTE OF CHEMICAL ENGINEERS.—June 22-24. Semi-annual meeting at Niagara Falls, N.Y. Secretary, J. C. Olsen, Polytechnic Institute, Brooklyn, N.Y.

THE AMERICAN PEAT SOCIETY will meet at Ottawa, Ont., July 25-26-27, 1910. Secretary and Treasurer, Julius Boodollo, Kingsbridge, New York City.

NEW ENGLAND WATER WORKS ASSOCIATION.—September 21-23. Annual meeting, Rochester, N.Y. Willard Kent, Secretary, Narragansett Pier, R.I.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—October 11-16. Seventeenth annual convention, Erie, Pa. Prescott Folwell, Secretary, 239 W. 39th Street, New York, N.Y.

NATIONAL MUNICIPAL LEAGUE.—November 14-18. Annual meeting, Buffalo, N.Y. Clinton Rogers Woodruff, Secretary, North American Building, Philadelphia, Pa.

TORONTO, CANADA, JUNE 16, 1910.

CONTENTS OF THIS ISSUE.

RAILWAY EARNINGS; STOCK QUOTATIONS.

Figures for the Past Week and from Beginning of Year, with Comparisons and Stock Prices.

The following table gives the latest traffic returns it is possible to obtain at the time of going to press:—

Road	Wk. Ended	1910	Previous Week	1909
C. P. R.	June 7	$1,841,000	$2,754,000	$1,424,000
G. T. R.	June 7	191,354	1,208,103	688,306
C. N. R.	June 7	266,200	359,300	186,300
T. & N. O.	May 31	41,756	25,247	37,878
Mont. St.	May 11	85,087	83,563	77,781
Halifax Elec.	May 4	4,203	5,155	3,425

Figures showing the earnings of Canadian roads since January 1st, this year and last, are appended:—

Road.	Mileage.	Jan. 1st to	1910.	1909.
C. P. R.	10,236	June 7	$37,419,000	$31,471,000
G. T. R.	3,536	June 7	18,482,428	15,402,113
C. N. R.	3,180	June 7	4,993,300	34,534,300
T. & N. O.	264.74	May 31	499,649	414,886
Mont. St.	141.79	June 11	1,843,320	1,597,196
Halifax St.	13.3	June 4	81,483	71,412

Stock quotations on Toronto, Montreal and London exchanges, and other information relative to the companies listed in the above tables, are appended. The par value of all shares is $100.

Co.	Capital 000's omitted.	Price June 10 1909.	Price June 2 1910.	Price June 9 1910.	Sales last week.
C.P.R.	$150,000	183¾	....	196	775
Mont. St.	18,000	218½-218	242-241½	242-241	3,460
Tor. St.	8,000	126	119¼	120	211
Halifax Elec.	1,400	117-115	125-123	124¼-123	24
G.T.R.	226,000				

TORONTO STREET RAILWAY EARNINGS.

A cheque from the Toronto Railway Company for $57-737 has been received by City Treasurer Coady, this being the city's percentage on gross receipts of the company for last month. The percentage is $8,393 more than was paid to the city by the company in May, 1909. The increase in company's gross receipts in May, 1910, over receipts in May, 1909, amounted to $32,292. The total last month was $361,254.

CALGARY STREET RAILWAY.

Figures Showing Earnings and Operating Expenses Since January—Interesting Notes on Equipment.

The month of May shows a profit of nearly $10,000 for the street railway system, the summary being as follows:—

Statement of gross revenue and operating expenses, May, 1910.

Revenue—	
Passenger earnings	$16,445.40
Miscellaneous earnings	465.00
	$16,910.40
Operating expenses—	
Maintenance of way and structures	$ 7,508.10
Balance revenue over operating expenses	9,402.30
	$16,910.40

Proportion operating expenses to revenue 44 per cent.

In view of the street railway system to be undertaken in other Canadian cities the following facts in connection with the Calgary system may be of interest:—Track in operation, 16½ miles, twelve miles of which is route, cost per mile, $12,000, if 60-lb. steel instead of 80-lb. steel used, the estimate on unpaved streets is $10,000 per mile. No old street plant used. The power used to operate is D. C. 550 volt., and the cost 2½c. per k.w. hour.

A car of the Calgary type consumed when loaded, 2 k.w. hours per mile. One thousand horse-power boilers, engine and generator installed at a cost of $50,000. Eleven ordinary cars are in service and one extra. The cost per car was $5,600 f.o.b. Calgary. The cars are 41 feet 6 inches long, and have cross seats upholstered in rattan, capable of seating forty passengers.

The overhead poles, wire, etc., 60 feet high, and rails 60 feet long, cost $2 per foot, or $10,500 per mile. With reference to operations for the past four months of this year from January 1st to April 30th, the revenue has been as follows:—

Passenger earnings	$49,910.50
Miscellaneous	878.00
	$50,788.50
Operating expenses—	
Maintenance, building track and lines	$ 1,577.89
Maintenance, equipment	3,108.30
Transportation expenses	25,733.53
General expenses	1,831.55
	$32,251.27
Profit over operating expenses	$18,537.23
Deductions—	
Four months' interest	$ 7,740.00
Four months' sinking fund	3,123.52
	$10,863.52
Net profit for four months	$ 7,674.71

CANADIAN ELECTRIC RAILWAYS.

From week to week we propose to give, on our page devoted to transportation interests, particulars of the equipment, mileage, and other information regarding the railways of Canada, together with a list of the officials. This series of articles commenced in our issue of October 1st.

Previously given:—

Ontario.

Brantford and Hamilton Railway.
Chatham, Wallaceburg and Erie Railway.
Cornwall Street Railway.
Guelph Radial Railway.
Galt, Preston and Hespeler Railway.
London Street Railway.
International Transit Co., Sault Ste. Marie.
Kingston, Portsmouth & Cataraqui Elec. Ry., Kingston
Toronto and York Radial Railway.
Windsor, Essex and Lake Shore Railway.
Ottawa Electric Railway.
Southwestern Traction Co., London.
Toronto Street Railway.
Niagara, St. Catharines and Toronto Railway.
Peterborough Radial Railway.
Berlin and Waterloo.
Sarnia St. Ry. Co.
Toronto Suburban St. Ry. Co.
Hamilton Street Railway.
Port Arthur and Fort William Electric Railway.

Quebec.

The Montreal Terminal Railway Company.
The Montreal Street Railway Company.

THE HULL ELECTRIC COMPANY

General Manager, W. R. Baker, Montreal, Que.

General Superintendent and Chief Engineer, G. Gordon Gale, Deschenes, Quebec.

Kind of Road: Electric.

Length of Road: Single track, 3.5 miles.

Double track, 11.6 miles.

Total in single miles, 26.7.

Character of Service:

Number of cars, 32 cars, 3 sweepers, 3 plows, 2 locomotives.

Type, suburban and city.

Number of motors, suburban, 4 motors; city, 2 motors.

Power of motors, 40 h.p.

Method of controlling, individual K control.

Method of braking, suburban, air; city, hand brakes.

Gauge of track, 4 ft. 8½ inches.

Weight of rails, suburban, 56 lbs.; city, 90 lbs.

Power:

Voltage of transmission, 10,000 volts.

Trolley voltage, 550 volts.

Frequency of transmission for A.C., 60 cycles.

No. of phases, 3 phase.

Current collecting devices, 5" trolley wheels.

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 PENDING.

In addition to those in this issue.

Further information may be had from the issues of the Canadian Engineer referred to.

Place of Work.	Tenders Close.	Issue of.	Page.
Winnipeg, Man., railway bridge work	June 28.	May 6.	457
Girvin, Sask., telephone line	July 15.	May 20.	514
Lennox Island, P.E.I., wharf construction	June 27.	June 3.	569
Liscomb, N.S., wharf extension	June 24.	June 3.	569
Saskatoon, Sask., hospital extensions	June 30.	June 10.	52
Wingham, Ont., sewers	June 21.	June 10.	52
Fergus, Ont., bridge construction	June 22.	June 10.	52
Edmonton, Alta., interior equipment asylum	June 30.	June 10.	596
Vancouver, B.C., dredge	July 20.	June 10.	596
Tadousac Harbor, Que., wharf	June 29.	June 10.	596
Levis, Que., wharf	July 5.	June 10.	596
Stellarton, N.S., tenement houses	June 25.	June 10.	596
Little Tancook Island, N. S., breakwater	July 4.	June 10.	596

TENDERS.

Hampton, N.S.—Tenders will be received until July 4th for the construction of an extension to the breakwater. R. C. Desrochers, Assistant Secretary, Department of Public Works, Ottawa.

Montreal, Que.—The Dominion Bridge Company has been awarded the contract for the construction of the steel superstructure of the Canadian Pacific Railway bridge at Lachine, the reconstruction of which was announced a few days ago.

Montreal, Que.—The contract for the pier work on the St. Lawrence River bridge, to be constructed by the Canadian Pacific Railway presently, has been let to the Foundation Company, Ltd., of the Bank of Ottawa Bldg., Montreal. The Foundation Company will lengthen out the existing fifteen piers to twice their present length, and in addition will construct two new piers. The work is being done in view of the decision of the C. P. R. to place double tracks across the bridge in order to accommodate the increased traffic. Work will commence on the piers immediately.

Montreal, Que.—C. Beaulieu was awarded the Labelle Street sewer contract at $4,707.

New Richmond, Que.—Tenders will be received until July 11th for extension of wharf. R. C. Desrochers, Assistant Secretary, Department of Public Works, Ottawa.

Quebec, Que.—Tenders will be received until June 21st for Chaudiere waterworks and sewer construction. A. Leofred, Consulting Engineer, 39 St. John St., Quebec.

Quebec, Que.—The contract for the construction of a reinforced concrete dam for the St. Alban power station has been awarded to R. C. Argall Co., of Montreal, at a cost of $31,300. J. F. Guay, Consulting Engineer.

Quebec, Que.—Contracts for fire hose were awarded as follows: 1,000 feet "Red Cross," at $1, to Mechanic Supply Co., and 1,000 feet of "Arrow," at 95 cents, to the Canadian Rubber Co.

St. Malo, Que.—Tenders will be received until June 22nd for excavator's, mason's, bricklayer's, plasterer's, carpenter's, joiner's and roofer's work; also for steel erection work in connection with the enlargement of the car barn for Quebec Railway Light and Power Co. Staveley & Staveley, Architects, 92 St. Peter Street, Quebec.

Arnprior, Ont.—S. R. Rudd was given the contract for the High school addition at $12,907.

Berlin, Ont.—Tenders will be received until July 15th for the clearing and grading of twenty-nine miles of railroad, also for a number of car bodies and trucks, the construction of five bridge piers and one four-hundred-foot bridge. A. N. Warfield, Chief Engineer. (Adv. in The Canadian Engineer.)

Drayton, Ont.—Bowman & Connor, Consulting Engineers, of Toronto, have tabulated and awarded contracts as follows for two bridges in Wellington County:

Cole's Bridge—50 ft. steel superstructure.

Stratford Bridge Co.	933
Dickson Bridge Works Co.	1,154
A. Hill & Co.	1,115
Jenks Dresser Co.	1,115
Petrolea Bridge Co.	1,050
Western Bridge and Equipment Co.	897
Hamilton Bridge Works Co.	870
Hunter Bridge and Boiler Co.	850

	Arnold's Br., (233 cu. yds.) Abutments.	Cole's Br., (120 cu. yds.) Abutments.	Stirton Culvert.
Fraser & Clemens	$1,157	$ 1,581	$ 339
John Gaffney	1,265	670	400
J. B. Lichty & Son	1,466	588	439
E. C. Knoblach	1,195	600	420
John Langdon	1,198	660	450
John D. Callaghan	1,171*	564*	443
Simmons Bros.	....	....	374*
James Hilton	1,943	....	625

*Tenders accepted.

Dresden, Ont.—Tenders will be received until noon June 20th, for all tenders in the erection of a concrete, brick, etc., school building. J. P. Bridgewater, Secretary P. S. B., Dresden; J. L. Wilson & Son, Architects, Chatham.

Fort William, Ont.—Tenders have been received and contracts awarded as follows:

Street Railway Material:—

Cull Ties, J. C. Hunter, each	$ .21
Cedar Poles, J. C. Hunter, per foot	.15½
Spikes, Fife Hardware Co., per 100 lbs.	2.47
Bolts, Northern Engineering and Supply Co., per 100 lbs. F.O.B. West Fort	3.60
Washers, R. S. Piper Co., per 100 lbs., F.O.B. West Fort	13.00
Gravel, Mount McKay and Kakabeka Railway Co., per yard	.65
Weatherproof Feeder Wire, Canadian General Electric Co., per 100 lbs.	16.70
Copper Trolley Wire, Eugene F. Philips Electric Works, Ltd., per 100 lbs.	15.49
Steel Rail Bonds, United States Export Co., each, 29c., 37c. and	.63
Rail Joints, Rail Joint Company, each	1.53
Steel Rails, Algoma Steel Co., per ton	32.50
Strain Insulators, Northern Electric Co., per 100	27.50
5-16 Span Wire, Northern Electric Co., per 100 lbs.	4.50
3-8 Span Wire, Northern Electric Co., per 100 lbs.	4.30
Fork Bolts, Northern Electric Co., per 100 lbs.	26.87
Cone Hangers, Canadian General Electric Co., each	.54
Single Pullovers, Canadian General Electric Co., each	.67
Double Pullovers, Canadian General Electric Co., each	1.10
Clinch Ears, Dawson & Company, per 100	32.50

Tenders on sewers were received as follows:

	10 & 11	10 & 12	10 & 13	14
Alto & Jacobson		$13,297		
E. S. Rutledge	$51,685	12,886	$18,288	$4,675
T. McCallum				3,900
Stewart & Hewitson	51,750			

	10 & 11	10 & 12	10 & 13	14
Stewardson Bros.	60,761	12,759	16,280	4,700
Laidlaw & Grant	54,000			
C. Donati		12,900		
A. Cameron	64,145	29,681	23,525	4,529
H. Murphy	62,000	17,000	27,550	5,200
J. J. Flanagan	51,000	13,750	22,500	4,000
H. S. Hancock	49,500	13,140	18,954	4,315

Recommended that T. McCallum be awarded the contract for sewer 10—14 at $3,900.

Recommended that Stewardson Bros. be awarded the contract for sewer 10—13 at $16,280, and contract for sewer 10—12 at $12,759 be accepted.

Recommended that the work on Francis Street sewer be awarded to Engineer at his tender, $49,500.

Tenders on Simpson Street bridge were received as follows:

S. Morran	$22,000
A. Cameron	23,545
E. G. Penniman	29,500
J. J. Flanagan	24,500
H. Murphy	26,200

The city engineer suggested that the bridge should be built between $20,000 and $22,000, and it was decided to build it by day labor.

Oneida Indian Reserve, Ont.—Tenders will be received until June 25th for the erection of a brick schoolhouse on concrete foundations. J. D. McLean, Secretary, Department of Indian Affairs, Ottawa.

Port Arthur, Ont.—In connection with the new drydock of the Western Drydock and Shipbuilding Co., there will be a blacksmith shop, with 15 forges and welding machines, one 2-ton and one 5-ton crane, a large steam hammer, a punch shed, containing, besides other tools suitable for such equipment, one 18-foot 8-in. roll, one roll 18 feet 5½ in., manhole punch, 5 smaller punches for rivet holes, etc., 2 shears, 2 planers, 1 mangle roll, and a travelling crane. On one side of this shop will be a tool and store room, containing a drill press, plate drill, punch and angle shears, 7 cold press punches, a large angle and plate furnace, all taken care of by an overhead crane. There will be a two-storey joiner shop, a power house, where the 500-h.p., which will be used, will be re-distributed to the various departments on a modern switch-board, a machine shop, with two 15-ton travelling cranes in the body of the shop, and smaller cranes in the bay. This shop will be equipped with the most modern appliances for economical handling of the work. A pattern shop and pattern store, three-storeys high, constructed entirely of brick and steel. A boiler shop, a 20-ton crane in the bay, and two 15-ton cranes in the centre of the shop. There will be installed in this department, annealing furnaces, plate rolls, etc., a foundry, served with two 15-ton travelling cranes, with the most modern cupolas, core rooms, etc.

The docks will be served by two 80-ton shear legs for loading boilers, etc., and will be of cement construction, with the necessary pit at one end for shipping of rudders, supplied with powerful pumps for the discharge of water.

Toronto, Ont.—Tenders will be received until June 27th for the construction of concrete abutments and a reinforced concrete truss bridge over the Humber River. Barber & Young, Consulting Engineers. (Adv. in The Canadian Engineer.)

Walkerville, Ont.—Tenders will be received until June 14th for the construction of granolithic walk. Cecil H. Robinson, Town Clerk.

Smith's Falls, Ont.—Tenders will be received until June 20th for the construction of approximately 40,000 square feet of concrete walks. J. A. Lewis, Town Clerk.

Toronto, Ont.—Tenders will be received until June 23rd for wire and pole line supplies. G. R. Geary (Mayor), Chairman, Board of Control.

Toronto, Ont.—Tenders will be received until June 21st for mason work, roofing, plumbing and painting in connection with sub-station. G. R. Geary (Mayor), Chairman, Board of Control.

Toronto, Ont.—Tenders will be received until June 28th for the erection of a new band stand in the Exhibition grounds. G. R. Geary (Mayor), Chairman, Board of Control.

Winnipeg, Man.—Tenders will be received until June 16th for sewers, granolithic walk, cedar block pavement, asphalt pavement, creosote block pavement, and water main. M. Peterson, Secretary, Board of Control Office.

Winnipeg, Man.—Tenders will be received until June 20th for the erection of approximately 2,500 lineal feet wire fencing. J. H. Blackwood, Secretary, Public Parks Board Office.

Kindersley, Sask.—Tenders will be received until June 22nd for the boring of a well to supply water for the village. Edward J. Russel, Secretary-treasurer, P.O. Box 29.

Pense, Sask.—Tenders will be received until June 23rd for the erection of a town hall. J. F. Weiss, Secretary-treasurer, village of Pense.

Regina, Sask.—Tenders will be received until June 18th for the erection of an officers' quarters at the R.N.W.M.P. Barracks. R. S. Knight, Inspector, Supply Officer.

Calgary, Alta.—Tenders will be received until June 20th for the supply of vitrified conduit. H. E. Gillis, City Clerk.

Calgary, Alta.—Tenders will be received until July 12th for one 750 B.H.P. engine, 300 R.P.M., with condenser; also one 600 K.W.D.C. 600 volt generator switchboard, etc. H. E. Gillis, City Clerk. (Advertisement in The Canadian Engineer.)

Calgary, Alta.—Tenders will be received until June 20th for the erection of a business block. Hodgson & Bates, Grain Exchange.

Lethbridge, Alta.—Tenders will be received until June 30th for plumbing, electric wiring, heating, ventilation and mechanical equipment required in the construction of a jail building. John Stocks, Deputy Minister of Public Works, Edmonton, Alta.

Ponoka, Alta.—Tenders will be received until June 30th for plumbing, heating, ventilations and other mechanical equipment in connection with an asylum building. John Stocks, Deputy Minister of Public Works, Edmonton.

Nanaimo, B.C.—Tenders will be received until June 24th for the excavation and laying only of vitrified sewer pipes. Allan Waters, City Engineer. (Advertisement in The Canadian Engineer.)

Proctor, B.C.—Tenders will be received until Wednesday, June 22nd, for the erection and completion of an hotel building at Riverside, near Proctor, British Columbia, for the Canadian Pacific Railway Company. The company's superintendent at Nelson, B.C., has plans. Wm. Wallace Blair, Architect, Winnipeg.

Riverside, B.C.—Tenders will be received until June 22nd by the C.P.R. for the erection of an hotel building. Wm. Wallace Blair, Architect, 400 The Nanton Building, Winnipeg.

Vancouver, B.C.—Tenders will be received until June 29th for lining the Little Mountain reservoir. Wm. McQueen, City Clerk, City Hall.

CONTRACTS AWARDED.

Cobourg, Ont.—Martin Jet & Co., of Cobourg, were awarded the concrete walk construction contract at 9 7-8 cents a square foot. The Forest City Paving and Construction Company, of London, Ont., tendered at 9 9-10 cents.

London, Ont.—Contract for a steel tower to be used in connection with electrical distribution was awarded to the Ontario Wind Engine and Pump Co., Toronto, for $585 f.o.b. London, and $175 for erection. Other bids ranged from $800 to $1,175.

Niagara Falls, Ont.—Contracts were let last week for the laying of the macadamized road between Niagara Falls and Bridgeburg. The total cost will be $95,000. Messrs. Cook and Menzie, of Niagara Falls, will build two sections, and H. Campaign, of Niagara Falls, the other half. The Niagara Falls Park Commission have charge of this work.

Ottawa, Ont.—The contract for section four of the Trent Valley Canal, Ontario-Rice Lake division, was awarded to Haney, Quinlan & Robertson, of Toronto and Montreal. The total amount of the contract is something over one million dollars. The same contractors were awarded the contract for district six last month, involving an expenditure of $600,000.

Port Colborne, Ont.—M. T. Hogan, of Port Colborne, was awarded the contract for improvements to the entrance of the Welland Canal at this point.

St. Thomas, Ont.—James A. Bell, city engineer, recently invited tenders for improvements to the Fulton bridge, in Southwold. The contract, which includes considerable concrete work and furnishing and driving piles, was awarded to Joseph Vincent, 165 Tecumseh Ave. Following is a list of the tenders:

Name.	Address.	Concrete per cubic yard.	Furnishing and driving. piles.
Jos. Vincent,	London	$4.00	$200
Chas. C. Stafford,	Jaffa, Ont.	6.00	250
Scoyne & Ramey,	Talbotville	5.45	....
G. A. Ponsford,	St. Thomas	4.50	10c
	(concrete block)	6.50	
Williams & Walker,	Muncey	6.75	150

Toronto, Ont.—The successful tenderers for the Brown School were: Mason work, Teagle and Sons, $16,366; steel work, Reid and Brown, $11,085; carpenter work, Frank Armstrong, $8,833; roofing, Flowers and St. Leger, $925; plastering, George White, $2,150; plumbing, Keith & Fitzsimons, $650; painting, J. Phinnemore, $1,245; heating and ventilating, J. R. Seager, $5,850; heat regulation, Johnston Temperature Regulation Co., $885.

For the new Earlscourt School:—Mason work, Teagle & Sons, $13,200; carpenter work, Frank Armstrong, $8,456; structural steel, W. A. Falter, $964; roofing, Flowers & St. Leger, $1,075; plastering, Beaver & Co., $1,296; plumbing, Keith & Fitzsimons, $1,345; heating and ventilating, Keith & Fitzsimons, $5,500; heat regulation, Johnston Temperature Regulation Co., $540; wiring, G. J. Beattie, $38.

For the Norway School:—Mason work, G. T. Gayton, $1,150; carpenter work, Frank Armstrong, $9,989; structural steel, Reid & Brown, $1,523; roofing, G. M. Bryan, $1,125; plastering, Beaver & Co., $1,635; plumbing, Fred. Armstrong, $1,184; painting, G. F. Egles, $1,340; heating and ventilating, Fred Armstrong, $6,498; heat regulation, Johnston Temperature Regulation Co., $749; electric wiring, G. J. Beattie, $38.

Woodstock, Ont.—Wm. Crellin, of Kintore, was awarded a contract by the County of Oxford for two concrete bridges near Thamesford, at $1,460.

Portage la Prairie, Man.—Jeffrey Bros. were given the contract for a new school building here at $13,350.

Prince Rupert, B.C.—The contract for sewer construction between 8th Street and Fulton Street has been awarded to S. P. McKord, whose bid for doing the whole work was $15,916.10. Two other bids were received as follows:

W. H. Mitchell & Co. $16,209
S. H. Watson & Co. 18,635

New York, N.Y.—The contract for the complete foundations, including Raymond concrete piles, for the Third National Bank Building, at Atlanta, Ga., has been awarded to the Raymond Concrete Pile Company, of New York and Chicago. Purdy & Henderson, Engineers.

RAILWAYS—STEAM AND ELECTRIC.

St. John, N.B.—A. W. Campbell, Deputy Minister of Railways, with Messrs. Tiffin, Brady and Pottinger, of the I. C. R. Board of Control, inspected the facilities here. They are going over the Hampton and St. Martin's Railway on an inspection trip. Mr. Campbell plans to inspect all the branch lines joining the I. C. R., and on his trip the decision in regard to the taking over of these lines will be determined.

Guelph, Ont.—Ratepayers will soon be asked to vote on a $35,000 by-law for the St. Patrick's Ward extension of the radial railway. Much new equipment will be needed after the extension is made, including two more cars, a freight motor and a snow sweeper.

Toronto, Ont.—The C. P. R. Company's plans for the elimination of the grade crossings at Yonge Street and Avenue Road, which have been filed with the City Engineer, involve raising the tracks at the bridge crossing Rosedale ravine east of Yonge Street, and the elevation of the tracks at Yonge Street twelve feet, and at Avenue Road ten feet, then running down to the present grade at Poplar Plains Road and Davenport Road. Subways are to be constructed at Yonge Street and Avenue Road the full width of the streets. The approaches are to have grades of from four to five per cent.

Winnipeg, Man.—Mr. William Whyte, second vice-president of the C. P. R., stated yesterday that the Canadian Pacific was preparing to continue the double tracking of the line between Portage and Brandon. The subgrade work on the section of the line from Winnipeg to Portage has been finished and the contractors, J. C. Hargrave & Co., have been ordered to continue west. When this work is finished the C. P. R. will have 522 miles of double track from Fort William west.

Regina, Sask.—The contract for the construction of the C. N. R. permanent roadway across Rainy Lake has been awarded to Foley, Welch and Stewart, and work has already been begun. The contract calls for the completion of the line in 1912.

Vancouver, B.C.—L. M. Rice, of L. M. Rice and Company, Seattle, engineers in charge of the construction of the British Columbia and Alaska Railway, has two survey parties in the field between the main line of the C. P. R. and Fort George. Each party is composed of seventeen men. One is working north from Lytton on the C. P. R., and the other south from Fort George. It is the intention of the company to have two more parties at work during the summer, one working northward from Fort George, and the other southward from Hazelton on the Skeena River.

Vancouver, B.C.—Foley, Welch & Stewart have been awarded the contract for the construction of a 25-mile section of the Kootenay Central Railway. The route of the railway follows the upper Kootenay and the upper Columbia valleys, traversing the Windermere district. From Galloway, a small station on the line of the Crow's Nest Pass branch of the C. P. R., the line will run to Fort Steele and thence proceed northward twenty-five miles. It is declared that on the completion of this short stretch, construction will be rapidly pushed till the entire line is finished.

LIGHT, HEAT AND POWER.

Weston, Ont.—This municipality has agreed to accept the Hydro-Electric Power Commission's offer to supply Niagara power.

Brandon, Man.—City Engineer Speakman has prepared plans for a new street lighting scheme.

BY-LAWS AND FINANCE.

Following municipalities recently sold debentures as noted:—

Brenda, Man.—$10,000.
Oxford Co., Ont.—$50,000, for roads.
Cornwall Township, Ont.—$59,127, drainage
Port Hope, Ont.—$12,000 local improvements.
Hamilton, Ont.—$12,000, schools.
Summerland, B.C.—$150,000.
Penticton, B.C.—$4,000, sidewalks.
London, Ont.—$357,822, power and waterworks extensions.
Elgin Township, Ont.—$30,000.
Scarborough Township, Ont.—$12,000, schools.

Ingersoll, Ont.—Tenders will be received up to June 18, for the purchase of $54,800 debentures for purchase of electric light plant and $15,000 for making necessary alterations and extensions. W. R. Smith, Town Clerk.

Niagara Falls, Ont. — Council decided to submit three by-laws to raise $15,000 to build a new assembly hall, gymnasium and collegiate; another $2,000 to repair the heating at the collegiate, and a third to raise $2,500 to build a new fire hall.

Smith's Falls, Ont.—The town of Smith's Falls invites tenders for the following debentures: $16,000, waterworks; $10,000, hospital; $4,660, local improvement. J. A. Lewis, Town Clerk.

Dauphin, Man.—The debenture by-laws, $11,000 for electric light purposes and $12,000 for school buildings and furnishings were carried.

Virden, Man.—A. W. H. Smith will receive bids until July 2nd, for $25,000 school debentures.

Calgary, Alta.—On Friday, June 10th, the ratepayers will vote on money by-laws aggregating $166,000 One of these is to raise $96,000 for grading the streets and thoroughfares leading into the city, another is for $60,000 for a trunk sewer and site for sewage disposal, and the third to raise $10,000 for sewer and catch basins.

Victoria, B.C—A $13,000 school by-law is being considered.

Nanaimo, B.C.—A $25,000 waterworks extension by-law will shortly be voted on.

Chilliwack, B.C.—A $70,000 drainage by-law will be submitted to the ratepayers.

Point Grey, B.C.—A $20,000 pavements by-law will shortly be submitted to the ratepayers.

Ladysmith, B.C.—The council has passed a by-law to raise $25,000 to improve its waterworks system.

Prince Albert, Sask.—On June 25th the ratepayers will vote on a $5,000 by-law and a $22,500 by-law.

Toronto, Ont. — The American Street and Interurban Railway Association has decided to hold its annual meeting in Atlantic City from October 10 to 14.

Welland, Ont.—It was recently announced that the head offices of the Ontario Iron and Steel Company and the Page-Hersey Tube Works will be moved from Toronto to Welland.

SEWERS, SEWAGE AND WATERWORKS.

London, Ont.—F. W. Farncomb, consulting engineer of this city, has successfully completed the new waterworks installation at Exeter.

High River, Alta.—On June 27, the ratepayers will vote on a by-law to incur an indebtedness of $121,000 for the installation of waterworks and sewage disposal works. Messrs. Chipman & Power, of Toronto and Winnipeg, are the consulting engineers.

MISCELLANEOUS.

Woodstock, N.B.—Council have decided to establish an incinerator.

Bridgeburg, Ont.—The Canada Foundry Company will convert into a structural steel plant the works of the Canadian Shipbuilding Company, which they recently purchased.

Ottawa, Ont.—Vickers, Sons and Maxim have filed plans with the Public Works Department for a shipbuilding and a ship repair plant to be located at Montreal, which will cost $2,500,000. The plant comprises a floating dry-dock, three berths for the repairing and building of steel vessels, as well as extensive machine shops, the whole plant to cover an area of fifty acres.

Winnipeg, Man.—Plans prepared by J. H. G. Russell have been accepted for the New Westminster Church and Sunday School buildings to cost about $150,000.

Vancouver, B.C.—Andrew Grey is making a survey in connection with the telegraph line to Stewart, which will be constructed immediately.

SOCIETY NOTES.

Central Railway and Engineering Club.—The third annual meeting of the above club will be held on Saturday, June 18th, to Beaverton Beach, by special train, on the C. N. O. Railway, leaving the Union Station, Toronto, at 9 a.m.

Canadian Street Railway Association.—Mr. Duncan McDonald, manager of the Montreal Street Railway, was reelected president of the Canadian Street Railway Association, which concluded its sessions at Montreal last week. The other officers elected were: Vice-president, James Anderson, Windsor; secretary-treasurer, Acton Burrows, proprietor, Railway and Marine World, Toronto; assistant secretary-treasurer, Aubrey Burrows, Toronto. Executive committee: James Hutchison, Ottawa; C. B. King, London; Mr. Hopper, St. John, N.B.; C. E. A. Carr, Quebec; and Wallace McCrae, Toronto.

The Canadian Gas Association.—The third annual convention of the Canadian Gas Association was held at Alexandra Rink, Hamilton, Ont., June 9th to 11th. Mr. J. C. Norris, of Montreal, president of the Association, presided. Several papers were read on subjects of interest to the delegates and local gas men. A joint report on "Candle Power and Calorific Value of Coal and Water Gas, as Supplied by Gas Companies and Corporations Throughout Canada," was given by John Keillor, of Hamilton; and Arthur Hewitt, manager of the Consumers' Gas Company, Toronto. Mr. E. A. Howe, of Hamilton, spoke upon the "Recent Gas Installations in Hamilton," and an interesting demonstration of sparkers in connection with gas engines was given by S. G. Buskard, of Hamilton.

R. A. Fraser, manager of the engine department of the Canadian Fairbanks Company, of Toronto, spoke at length on the construction and development of the gas engine. The paper was followed by a general discussion, during which Mr. Fraser answered many questions regarding the use of gas engines.

A feature of the morning session was the illustrated address given by Norman Macbeth, illuminating engineer of the Welsbach Company, of Gloucester, N.J., on the importance of an illuminating engineer to a gas company. Mr. Macbeth dealt with the question of sufficient and proper illumination, and the necessity of having a man who could properly estimate the cost of installation. In closing, he made comparisons between the cost of lighting by gas and electricity. A verbatum report will be given next week.

PERSONAL.

Readers are invited to forward notes of staff changes and new appointments for publication in this column.

Wm. Malcolm Davis, who was recently appointed city engineer of Prince Rupert, B.C., graduated from the R.M.C at Kingston in 1880, being one of the first graduates. Foi the first three years after graduation Mr. Davis was engaged on construction work on railways in Iowa and Missouri. Later he was made division engineer on construction.

In 1885, he came to the office of city engineer at St. Thomas, Ont., for one year, and in 1886, he was appointed engineer for the city of Woodstock and the county of Oxford.

In 1898, Mr. Davis was appointed town engineer for Berlin, and in addition to the work for the municipality, he engaged in private practice in the construction of municipal works. He devoted hs attention chiefly to waterworks and sewerage, being connected with the waterworks and sewerage system of Woodstock, Berlin sewage disposal works, Galt's sewage system and Guelph's waterworks. Mr. Davis is Lieutenant-Colonel in command of the cavalry regiment of Oxford and Waterloo, known as "Grey's Horses." He is president of the Berlin Canadian Club this year. He is also a member of the Canadian Society of Civil Engineers, and the Ontario Land Surveyors' Association.

Mr. Davis will be very much missed in Western Ontario, where he has so long taken a leading part in municipal improvement work. His experience with the difficult problem of disposing of the sewage at Berlin, and his long series of experiments as how best to treat this refuse, placed Mr. Davis before the public very prominently a few years ago.

In Western Canada, where he purposes taking up his new home, he will doubtless come quickly to the front as one of the leading municipal engineers.

Mr. A. W. Givin, has been appointed manager of the Standard Fitting & Valve Company, Guelph, Ont. Mr. Givin has already taken up his new work and expects to very shortly increase the business of this firm considerably.

Mr. G. T. Altham, city engineer, of Macleod, Alta., the mayor and several councillors recently resigned as the result of criticism of their work.

The Factory Products. Limited, Confederation Life Building, Toronto, of which Mr. H. G. Nicholls is president, have been appointed Canadian agents for the General Electrical Company, Limited, of London, England. This company are large manufacturers of electrical apparatus and supplies.

Dr. A. E. Barlow, formerly of the Geological Service; Prof. Gwilliam, of Queen's University, Kingston, and Mr. J. H. Valiquette of the Quebec Provincial Mining Bureau, left on Saturday to explore the Lake Chibougamon region, whch is 200 miles above Lake St. John.

Mr. R. Fraser Armstrong, B. Sc., has been appointed to a position on the engineering staff of the Grand Trunk Pacific Railway at Moncton, N.B.

Mr. J. G. Desbarats, the present Deputy Minister of Marine & Fisheries, has been appointed Deputy Minister of the new naval department. Mr. Alex. Johnston, of Sydney, C.B., will succeed Mr. Desbarats in the Marine Department.

Mr. E. L. Cousins, resident engineer of the Grand Trunk Railway, Toronto, has been recommended by the city engineer and the Board of Control for an appointment to the position of assistant engineer of the city of Toronto. If the council adopts the recommendation, Mr. Cousins will have charge of the railway engineering work which the city engineer's department will shortly have to handle.

Mr. M. Donovan has been appointed roadmaster for No. 6 division of the Grand Trunk Railway system, with headquarters at Kingston.

OBITUARY.

Mr. Charles E. Goad, well known throughout Canada as a civil engineer, passed away at his residence, 80 St. George Street, Toronto, June 10th, 1910.

The deceased was born in London, England, 62 years ago, and came to Canada as a young man. He made a specialty for 35 years of preparing plans for buildings from the fire risk standpoint, and served the insurance companies officially in that capacity. Mr. Goad gained for himself a high reputation throughout Great Britain and Canada in this respect.

Mr. Goad had lived in Toronto for the past 15 years and previously had his residence in Montreal, but from the nature of his work travelled considerably. Besides his local office at 15 West Wellington Street, he had offices in Montreal and London, England.

He was a member of the Canadian Society of Civil Engineers and the Engineers' Club, Toronto.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

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

10731—May 31—Approving location of the Grand Trunk Pacific Railway Company's Prince Rupert easterly mile 408.69 to mile 434.5, Fort George District, B.C.

10732—June 1—Authorizing the C.P.R. to construct the following bridges:—No. 131.7, Kitsuksus Creek, Alberni Extension, Esquimalt & Nanaimo Railway. No. 8.2, Michel Creek, Cranbrook Section, Western Division. No. 100.4, Portal Section, Western Division. No. 114.01, Cartier Section, Lake Superior Division. No. 113.5, Scott Creek, Cascade Section, Pacific Division.

10733—May 30—Directing that within sixty days from the date of this Order the Brandon, Sask., and Hudson's Bay Railway install a Whyte Signal Electric Bell at crossing of public road between Sections 24 and 13, Township 3, Range 20, Boissevain, Man.

10734—May 31—Approving location of the C.N.O.R. (Sudbury-Port Arthur Division) through unsurveyed territory in District of Algoma, mile 160 to mile 180.

10735—May 31—Authorizing the C.P.R. to lay an extra track across Seventh Street, High River, Alberta.

10736 to 10739 Inc.—May 31—Authorizing the C.P.R. to lay an extra track across the road allowances between Sections 32 and 33, Townships 11, Range 10, west Principal Meridian, at MacGregor Station, Manitoba; between Section 12, Township 8, Range 9, west Principal Meridian, and Section 7, Township 8, Range 8, west Principal Meridian, near Rathwell Station, Manitoba; between Sections 28 and 29, Township 11, Range 11, west Principal Meridian, at Austin Station, Alberta; between Sections 5 and 6, Township 11, Range 12, west Principal Meridian, at Sidney Station, Manitoba.

10740—June 1—Approving location of the Bay of Quinte Railway Company's station at Napanee, Ont.

10741—June 1—Authorizing the Bell Telephone Company to erect its underground conduit under the track of the Montreal Terminal Railway Company at Elmwood Farm Road Crossing, between Lots 38 and 40, Parish Longue Pointe, Que.

10742—June 1—Approving the standard twenty-foot arch culvert of the C.N.R.

10743—June 1—Approving clearance diagram for bridges in Canada on lines owned and controlled by the C.N.R.

10744—June 2—Authorizing the C.P.R. to construct bridge No. 21.7, on Moose Jaw Section, Western Division of its line of railway.

10745-46—April 26—Authorizing the C.N.O.R. to construct its line of railway across Meade Avenue, Brighton, Ontario, and across Prince Edward Street, Brighton, Ont.

10747-48—April 30—Authorizing the C.N.O.R. to construct its line of railway across Division Street and Railway Street, Brighton, Ont.

10749—May 19—Directing that within ten days from date of this Order the G.T.R. shall employ a watchman at the crossing at Hurontario Street, from the hours of 7 a.m., until 7 p.m., daily.

10750—May 19—Directing that within 30 days from the date of this Order the G.T.R. shall file plans for the erection of gates at the crossing of the 7th line; the Railway Company to erect such gates within 60 days after approval of said plans by the Board's Engineer, and to operate said gates from the hours of 7 a.m., to 7 p.m. daily, near Oakville, Ont.

10751—May 19—Directing that the G.T.R. file plan showing road to be constructed for the purpose of diverting the highway along the south side of its tracks at a skew crossing in the Township of Dorchester, Ont.; work to be completed within 90 days after approval of plans.

10752—May 19—Directing that the G.T.R. shall divert the highway, between Concessions 1 and 2, Township King, Ont., a short distance to south, and construct an overhead bridge at said crossing, the Railway Company to acquire necessary land to do the fencing, plans of said work to be filed for approval within 30 days from date of this Order, and the work to be completed within 60 days after approval of plans.

10753—May 31—Extending the time within which the C.P.R. shall construct spur to premises of Standard White Line Company as required by Order No. 9722, February 25, 1910, until the 15th August, 1910.

10754—June 1—Extending the time within which the C.P.R. was required by Order No. 9980 to erect crossing signs, cattle guards, and fencing on its Lacombe Branch from Stettler to Castor, until the 15th July, 1910.

10755—May 31—Authorizing the C.P.R. to construct its railway across thirty-two highways on its Langdon-North Branch from mile 0 to mile 39.45.

10756—May 30—10757—June 2—10758—June 2—10759—May 31—Authorizing the C.N.O.R. to construct its railway across public road between Lots 2 and 3, Concession 1, Township Brighton; across Centre Street, Brighton; across Napier Street, Brighton; across public road, between Lots 32 and 33, Concession "B," Township Brighton, County Northumberland, Ont.

10760—June 2—Ordering the Railway Company concerned in the following crossing be relieved, for the present, from providing further protection at the crossing named, it appearing from an inspection made by the Board's Engineer and Operating Department, and from plans furnished, that the view at the crossing is excellent from both directions; that the crossing signboards are properly placed, and that there are whistling posts on the railway:—G.T.R. crossing on Concession Road "D," near Scarboro Junction, Ontario.

10761—May 17—Approving the Uniform Bill of Lading in use in the United States and approved by the Interstate Commerce Commission as respects all traffic which may be carried from any point in the United States into Canada, or from the United States through Canada to the United States.

10762—May 23—Authorizing the T. N. & W. Railway Company to carry its railway across St. Clair Avenue, Toronto.

10763 to 10766—May 23—Authorizing the T. N. & W. Railway to cross with its tracks the tracks of the G.T.R. at St. Clair Avenue; of the G.T.R. (Northern Division), at Davenport Road; of the C.P.R. at St. Clair Avenue; and to construct its railway across Davenport Road, in the city of Toronto, Ontario.

10767—May 23—Directing that the Order of the Railway Committee of the Privy Council, dated December 16th, 1893, with reference to the protection of certain level crossings at Dufferin and Bathurst Streets, respectively, in Toronto, be varied by relieving the Township of York from its liability to contribute to the cost of maintenance of protection of said streets.

MARKET CONDITIONS.

Montreal, June 15th, 1910.

The market holds steady at recent prices:—

Antimony.—The market is steady at 8c. to 8¼c.

Bar Iron and Steel.—The market promises to advance shortly. Bar iron, $1.90 per 100 pounds; best refined horseshoe, $2.15; forged iron, $2.05; mild steel, $1.90; sleigh shoe steel, $1.90 for 1 x ⅜-base; tire steel, $2.00 for 1 x ⅜-base; toe calk steel, $2.40; machine steel, iron finish, $1.95; imported, $2.20

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 year will be the largest in the history of the country. Prices on foreign fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch). (164).

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 has advanced again, being now per 100 lbs., as follows:—¼-in., $5.30; 5-16-in., $4.70; ⅜-in., $3.90; 7-16-in., $3.65; ½-in., $3.55; 9-16-in., $3.45; ⅝-in., $3.40; ¾-in., $3.35; ⅞-in., $3.35; 1-in., $3.35.

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 strength, per 100 fuses:—4-ft. wires, $3; 6-ft. wires, $3.54; 8-ft. wires, $4.08; 10-ft. wires, $5

Galvanized Iron.—The market is steady. Prices, basis, 28-gauge, are:—Queen's Head, $4.10; Colborne Crown, $3.85; Apollo, 10¾ oz., $4.05. 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.—First boats are now arriving at Montreal, and importers are quoting prices, ex-wharf, about $1 per ton under prices ex-store. Following are the prices, on cars, ex-wharf, Montreal:—No. 1 Summerlee, $20.50 to $20.75 per ton; selected Summerlee, $20 to $20.25; soft Summerlee, $19.50 to $19.75; Carron, special, $20 to $20.50; soft, $19.50 to $20; Clarence, $17.25 to $17.50; Cleveland, $17.25 to $17.50 per ton.

Laths.—See Lumber etc.

Lead.—Prices are easier, at $3.35 to $3.45.

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 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 and prices are firmer, $2.40 per keg for cut, and $2.35 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 shows a steady tone although demand is on the dull side. Prices are firm, and approximately as follows:—$32 for 6 and 8-inch pipe and larger; $33 for 3-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 about the same, 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 71½ per cent. off for black, and 61½ per cent. off for galvanized; ¾-inch, $11.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $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 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 10¼c. for Manila. Wire rope, crucible steel, six-strands, nineteen wires; ¼-in., $2.75; 5-16, $3.75; ⅜, $4.75; ½, $5.25; ⅝, $6.25; ¾, $8; ⅞, $10; 1-in., $12 per 100 feet.

Spikes.—Railway spikes are firmer at $2.45 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 pounds. (See building paper; also roofing).

Tin.—Prices are firm, at $34 to $34.50.

Zinc.—The tone is easy, at 5¾ to 6c.

CAMP SUPPLIES.

Beans.—Prime pea beans, $2 to $2.25 per bushel.

Butter.—Fresh made creamery, 25 to 26c.

Canned Goods.—Per Dozen.—Corn, 80 to 85; peas, $1.05 to $1.15; beans, 85c.; tomatoes, 85 to 90c.; peaches, 2s, $1.65, and 3s, $2.65; pears, 2s, $1.60, and 3s, $2.30; salmon, best brands, 1-lb. talls, $1.87½, and flats, $2.02½; cheaper grades, 95c. to $1.65.

Cheese.—The market ranges from 11c. to 11½c., covering all Canadian makes.

Coffee.—Mocha, 20 to 25c.; Santos, 15 to 18c.; Rio, 10 to 12c.

Dried Fruits.—Currants, Filiatras, 5¾ to 6¼c.; choice, 8 to 9c.; dates, 4 to 5c.; raisins, Valentias, 5 to 6¾c.; California, seeded, 7½ to 9c.; Evaporated apples, prime, 8 to 8½c.

Eggs.—New laid, 20 to 22c.

Flour.—Manitoba, 1st patents, $5.60 per barrel; 2nd patents, $5.10; strong bakers, $4.90.

Molasses and Syrup.—Molasses, New Orleans, 27 to 28c.; Barbadoes, 40 to 45c.; Porto Rico, 40 to 43c.; syrup, barrels, 3½c.; 2-lb. tins, 2 dozen to case, $2.50 per case.

Potatoes.—Per 90 lbs., good quality, 45 to 50c.

Rice and Tapioca.—Rice, grade B., in 100-lb. bags, $2.75 to $2.80; C.C., $2.65. Tapioca, medium pearl, 5¾ to 6c.

Rolled Oats.—Oatmeal, $2.20 per bag; rolled oats, $2, bags.

Sugar.—Granulated, bags, $5.05; yellow, $4.65 to $5. Barrels 5c. above bag prices.

Tea.—Japans, 20 to 38c.; Ceylons, 20 to 40c.; Ceylon, greens, 19 to 25c.; China, green, 20 to 50c.; low-grades, down to 15c.

Fish.—Salted.—Medium cod, $7 per bbl.; herring, $5.25 per bbl.; salmon, $15.50 per bbl., for red, and $14 for pink. Smoked fish.—Bloaters, $1.10 per large box; haddies, 7½c. per lb.; kippered herring, per box, $1.20 to 1.25.

Provisions.—Salt Pork.—$27 to $34 per bbl.; beef, $18 per bbl.; smoked hams, 16 to 20c. per lb.; lard, 16½ to 17½c. for pure, and 12½ to 14c. per lb. for compound.

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Toronto, June 16th, 1910.

A moderate movement goes on in metals and hardware, with few features of interest. While prices are meanwhile steady, it is reasonable to look for higher figures for certain domestic hardware products of iron and steel, if the much talked-of western merger is completed. This merger would include the Montreal Rolling Mills Company, the Hamilton Iron Company, the Canada Screw Company, and the Canada Bolt & Nut Company. Mr. Plummer has announced, at Sydney the other day, that the Dominion Steel Company will presently go into the manufacture of wire, wire nails, screw-hooks, spikes, etc.

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

Antimony.—Trade is quiet, market steady at 9c. per lb.

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

Bar Iron.—$2.00 to $2.10, base, per 100 lbs., from stock to wholesale dealer. Free movement.

Bar Mild Steel.—Per 100 lbs., $2.10 to $2.20.

Boiler Plates—¼-inch and heavier $2.20. Boiler heads 25c. per 100 pounds advance on plate. Tank plate, 3-16-inch, $2.40 per 100 pounds.

MARKETS—Continued on page 634.

MARKETS—Continued from page 630.

Boiler Tubes.—Orders continue active. Lap-welded, steel, 1¼-inch, 10c.; 1½-inch, 9c. per 10 foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.00; 3-inch, $11 to $11.50; 3½-inch, $18 to $18.50; 4-inch, $19 to $20 per 100 feet.

Building Paper.—Plain, 27c. per roll; tarred, 35c. per roll. Demand is moderate.

Bricks.—In active movement, with very firm tone. Price at some yards $9 to $9.50, at others, $9.50 to $10 for common. Don Valley pressed brick are in request. 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., 75c. until further notice, per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. Rubble stone, 55c. per ton, Schaw station, and a good deal moving. Broken granite is selling at $3 per ton for good Oshawa.

Cement.—Car lots, $1.75 per barrel, without bags. In 1,000 barrel lots $1.60. In smaller parcels $1.90 is asked by city dealers. Bags, 40c. extra. Demand good.

Coal.—The price of anthracite still remains at $6.50 per ton, net, and pea coal at $5.75; but as the usual monthly advances have been made at the mines, a higher figure may be anticipated in the near future. From these prices a discount of 25 cents per ton can be had on considerable lots. 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, $3.75 to $3.80; mine run, $3.65 to $3.70; slack, $2.75 to $2.85; lump coal from other districts, $3.55 to $3.70; mine run 10c. less; slack, $2.60 to $2.70; cannel coal plentiful at $7.50 per ton; cook, Solvey foundry, which is largely used here, quotes at from $5.75 to $6.00; Reynoldsville, $4.90 to $5.10; Connellsville, 72-hour coke, $5.25.

Copper Ingot.—The consumption of copper everywhere is enormous, and production keeps up also. The market may be termed steady at 14c., firm here.

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

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

Felt Roofing.—The spring trade has opened very well at an unchanged price, which is $1.80 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. Fire clay, $8 to $12 per ton.

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.

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.—A steady request at former prices:—Black, ¼-inch, $2.03; ⅜-inch, $2.25; ½-inch, $2.63; ¾-inch, $3.28; 1-inch, $4.70; 1¼-inch, $6.41; 1½-inch, $7.70; 2-inch, $10.26; 2½-inch, $16.30; 3-inch, $21.52; 3½-inch, 27.08; 4-inch $30.78; 4½-inch, $35.75; 5-inch, $30.85; 6-inch, $51.70. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

Pig Iron.—We quote Clarence at $20.50, for No. 3; Cleveland, $20.50; Summerlee, $22; Hamilton quotes a little irregular, between $19 and $20. A fair quantity is moving, but the fresh inquiry is not large.

Lead.—A very fair demand exists; price, $3.75 to $3.85.

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 without freight. Demand is moderate.

Lumber.—Dimension stuff is in brisk demand, for present or later delivery. Prices are generally firm, especially in pine. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $28 to $33; 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, $17 to $17.50; spruce flooring, car lots, $22 to $24; shingles, British Columbia, are steady, we quote $3.10 lath growing scarce and stiffening, No. 1, $4.60, white pine, 48-inch; No 2, $3.75; for 32-inch, $1.70.

Nails.—Wire, $2.35 base; cut, $2.60; spikes, $2.85 per keg of 100 lbs.

Pitch and Tar.—Pitch, unchanged at 70c. per 100 lbs. Coal tar, $3.50 per barrel. Demand moderate.

Plaster of Paris.—Calcined, New Brunswick, hammer brand, car lots, $1.95; retail, $2.15 per barrel of 300 lbs.

Putty.—In bladders, strictly pure, per 100 lbs., $2.25; in barrel lots, $2.10. Plasterer's, $2.15 per barrel of three bushels.

Ready Roofing.—An active demand; prices are as per catalogue

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 Bangor slate 10 x 16 may be quoted at $7 per square of 100 square feet, f.o.b., cars, Toronto; seconds, 50c. less. Mottled, $7.25; green, $7, with a prospect of advance. Dealers are fairly busy.

Rope.—Sisal, 9½c. per lb.; pure Manila, 10½c. per lb., Base.

Sand.—Sharp, for cement or brick work, 90c. per ton f.o.b., cars, Toronto siding.

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	$3.2[illegible]
Single junction, 1 or 2 ft. long	.90	1.35	2.70	3.40	4.50	14.6[illegible]
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 moderate; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail.

Steel Beams and Channels.—Active.—We quote:—$2.75 per 100 lbs., according to size and quantity; if cut, $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.—Current price for rails at the Soo, $32 to $34 for weights 60 to 100 lbs.

Sheet Steel.—American Bessemer, 10-gauge, $2.50; 12-gauge, $2.55; 14-gauge, $2.35; 17, 18, and 20-gauge, $2.45; 22 and 24-gauge, $2.55; 26-gauge, $2.65; 28-gauge, $2.80.

Sheets Galvanized.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.00; 12-14-gauge, $3.00; 16, 18, 20, $3.20; 22-24, $3.35; 26, $3.50; 28, $3.95; 29, $4.25; 10¾, $4.25 per 100 lbs. Fleur de Lis—28-gauge, $4.10; 26, $3.80 per 100 lbs. A very large tonnage of all sorts has been booked.

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.—In spite of limited fluctuations abroad, 35c. is still the price. A fair movement continues.

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

Zinc Spelter.—The market can no longer be described as lively; a steady but limited movement goes on at $5.65 to $5.90 per 100 lbs.

CAMP SUPPLIES.

Butter.—Dairy prints, 18 to 20c.; creamery prints, 22 to 23c.; the creamery output is now increasing every week.

Canned Goods.—Peas, $1.15 to $1.75; tomatoes, 3s, 85c. to 95c.; pumpkins, 3s, 90 to 95c.; corn, 80 to 85c.; peaches, 2s, white, $1.50 to $1.60; yellow, $1.90 to $1.95; strawberries, 2s, heavy syrup, $1.50 to $1.85; raspberries, 2s, $1.50 to $1.95

Cheese.—Moderately firm; old cheese, large, 12¾c.; twins, 13c.; new, 11½ to 11¾c.

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

Dried Fruits.—Raisins, Valencia, 5¾ to 6¼c.; seeded, 1-lb. packets, fancy, 7½ to 8c.; 16-oz. packets, choice, 7 to 7½c.; 12-oz. packets, choice, 7c.; Sultanas, good, 5 to 6c.; fine, 6 to 7c.; choice, 7 to 8c.; fancy, 8 to 9c.; Filiatras currants 6½ to 7c.; Vostizzas, 8½ to 9c.; uncleaned currants, ½c.

Flour.—Manitoba Flour.—Quotations at Toronto are:—First patents, $5.20; second patents, $4.90; strong bakers', $4.75. Ontario Flour.—Winter wheat patents, $4.10 per bbl.

Lard.—Tierces, 15¾c.; tubs, 16c.; pails, 16¼c.

Molasses.—Barbadoes, barrels, 37 to 45c.; West Indian, 27 to 30c.; New Orleans, 30 to 33c, for medium.

Pork.—Market very firm, short cut, $29 to $30 per barrel; mess, $27 to $28.

Rice.—B. grade, 3¼c. per lb.; Patna, 5 to 5¾c.; Japan, 5 to 6c.

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

Smoked and Dry Salt Meats.—Long clear bacon, 15 to 15½c. per lb., tons and cases; hams, large, 17c. to 17½c.; small, 17½ to 18½c.; rolls, 15 to 15¼c.; breakfast bacon, 19 to 20c.; backs (plain), 20 to 21c.