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The Canadian Engineer

ESTABLISHED 1893.

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

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TORONTO, CANADA, FEBRUARY 25th, 1910.

CONTENTS OF THIS ISSUE.

AN EIGHT-HOUR LABOR LAW.

The contractors and engineers of Canada will be very much interested in Bill No. 21, which is being introduced into the Canadian House of Commons by Mr. Verville. The provisions of the bill are:—

1. Every contract to which the Government of Canada is a party, which may involve the employment of laborers, workmen or mechanics, shall contain a stipulation that no laborer, workman or mechanic in the employ of the contractor or sub-contractor, or other person doing or contractting to do the whole or a part of the work contemplated by the contract, shall be permitted or required to work more than eight hours in any one calendar day, except in cases of extraordinary emergency caused by fire, flood or danger to life or property.

2. Every such contract hereafter made shall contain a provision that unless the person or corporation making or performing it complies with the provisions of this Act, the contract shall be void, and the person or corporation shall not be entitled to receive any sum, nor shall any officer, agent or employee of the Government of Canada pay or authorize payment from the funds under his charge or control to the person or corporation for work done upon or in connection with the contract which in its form or manner of performance violates the provisions of this Act.

3. This Act shall apply to work undertaken by the Government of Canada by day labor.

The question of an eight-hour day has been much debated. An eight-hour day is not all good for the workingman nor all bad for the contractor.

As a rule the contractor will get more work per hour in an eight-hour day than in a ten-hour day, but in this bill there is one danger that should be avoided.

It should not be allowed to become law until such time as all Government contracts now let or under way are completed.

All Government contracts carry a fair wage schedule. Conditions will, and do, demand that men working eight hours shall receive the same wages per day as men working ten hours. The contractor now working will be unable to secure men to complete his work unless he advances his wages, and frequently any advance would turn a profitable contract into a losing undertaking.

The bill should be carefully considered, and if necessary the contractors should be prepared to present their views on the measure at a meeting of a Special Committee of the House of Commons on March 9th, 1910.

THE GERMAN SURTAX.

The Canadian Engineer does not wish to discuss trade relations or tariff questions, but the recent an-

nouncement that Canada and Germany had come to a new understanding in matters of trade, export and import, is of unusual interest just now to engineers and engineering firms in Canada.

The tariff war between Germany and Canada has been in progress since 1903, Germany penalizing Canada when Canada offered Britain a preference by placing on Canadian produce the maximum tariff; Canada retaliating by placing a surtax of 33⅓ per cent. against imports from Germany; i.e., a tax of 33⅓ per cent. above the tax imposed on goods entering Canada from countries other than Great Britain.

Canada is now on the German favored list and the German surtax is removed. This announcement, coming as it does just when so many Canadian public works, power schemes, hydraulic development and sanitary improvement undertakings are nearing perfection will doubtless delay matters for some time.

The domestic and export trade of Great Britain has been for the last few years very dull, the British manufacturers, looking for a new outlet, undertook to develop Canadian trade. Under the protection and preference offered by Canada and in competition with Canadian firms they have secured a number of Canadian contracts.

A new element now enters into the calculations in reference to the purchase of many classes of machinery and supplies required by Canadian engineering firms.

The Germans have been for years producing goods of a first class quality. Their labor and raw material are cheap. They are well supplied with technical men and their entrance into the Canadian field will augment the already keen competition which now exists between Canadian and British firms for Canadian business.

THE RAILWAY AND THE RURAL DISTRICT.

Somehow the impression has got abroad that the railways have been and are being built for the good of the cities and the city population. In matters of railway legislation the rural members find it good politics to always oppose the railways, adding restrictions to their charters, sometimes forgetting that the railways have done as much as any other one agency to increase land values.

Railways never make any pretence at being philanthropic institutions, and before they will venture into new territory they must be reasonably sure of returns. In the great Canadian West land could be had for the asking—the railways came and the land value increased by leaps and bounds.

Why should not the railways receive some returns because of this increase in value?

The New York Central Railway is now preparing to conduct an interesting experiment in one of the older-settled districts of New York State. They are securing three farms along their line of railway in different localities. By proper management this railway hopes to show how the production of the farm may be largely increased; how by the growing of certain crops and by careful packing and direct shipping the returns per acre from farm land will be greatly increased.

Such an object lesson will interest the farmer and the railway, will increase the traffic, both ways, on the railroad, and incidentally it will also increase the revenue.

A great cry is heard to-day as to the cost of living and the part the cold storage companies play in this increase. The engineer, by improving and directing transportation facilities, can lessen the cost to the consumer and yet increase the producers' selling price.

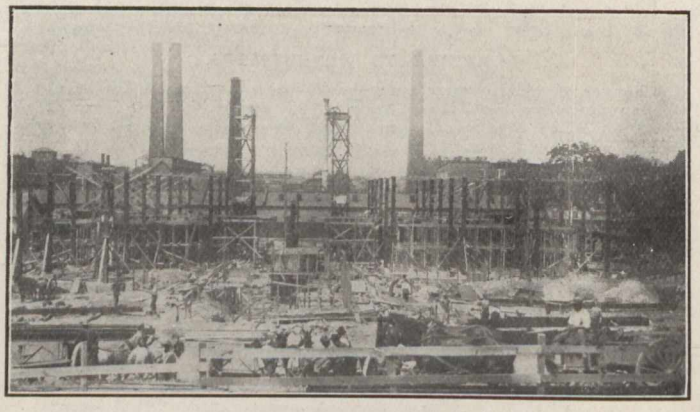
EDITORIAL NOTES.

Mr. James P. Murray, of the Canadian Manufacturers' Association, speaking at the Engineering Society of the University of Toronto dinner, referred very pointedly to the necessity of industrial educational training. The race for industrial supremacy is going to be keen. It will be won by a nation of trained men.

RAISING LABOR EFFICIENCY BY RIVALRY.

Every workable device for increasing the efficiency of labor is of importance to the contractor, and there is, therefore, considerable suggestive value in the experience of the Aberthaw Construction Company, of Boston, with the competitive working of labor gangs engaged in similar work on the same job. The Aberthaw Company has for years past used this device for stimulating labor whenever the circumstances of a construction job made a friendly rivalry between gangs possible. The most striking results of the system, however, were obtained in the recent construction of twin buildings for the Winchester Repeating Arms Company, at New Haven, Connecticut.

The work consisted of two buildings lying side by side, and connected by a middle structure which provided toilet



General View.

rooms, elevators, and a passage-way between the two wings. With the exception of a steel-frame, plaster walled storage room to go on the roof of one of them, the wings were precisely alike, each 300 ft. by 60 ft., two stories high with columns spaced 20 by 24 feet and built heavily enough to allow of the later addition of two more stories. The interior had flat slab concrete floors built on the Turner mushroom system supported by steel columns. There was a tunnel running under both buildings.

The amount of work involved in each building was carefully estimated, and a dividing line was drawn 6 ft. 8 in. on one side of the centre of the connecting corridor so as to mark off two equal jobs; two foremen who were to be put in charge of the two buildings agreed, after seeing the estimates, that the division was an absolutely fair one. They snapped up a cent for choice of sides. The two competing gangs were given duplicate equipment, the foremen were al-

lowed to select their labor bosses, carpenter foremen, and to some extent were given a free hand in the number of carpenters and laborers that were to be employed on their respective buildings. A bonus was promised to these two foremen, to be divided in a given proportion according to the labor economy realized on the two buildings in executing the work.

The Aberthaw Company organized the job on the plan followed in all its larger work. A superintendent, with such clerks as he required, was given responsible charge of the entire job, and the handling of all local and minor business details. He reported to the president of the company who visited the work at short intervals and put in such time as was necessary. In addition to the superintendent the company detailed from its own permanent forces a time-keeper; two foremen, one for each wing of the building; one labor boss; and a carpenter boss with six or eight experienced men under him for each wing. All the rest of the labor force was recruited on the ground. The company uses an accounting system which shows unit cost of each item, the progress, and the cost of labor and material used. On this job the reports on each wing were kept separate. Placing the forms and handling the concrete naturally made up the chief labor cost of the work.

Rivalry between the two sides began at the start of the jo and continued with increasing keenness until the end.

Reinforcement in place.

The carpenters on the two wings were separated only by the width of the central court and were in plain view of each other. The amount of centreing placed by the carpenters on one side was carefully noted by the men on the corresponding work of the other building, who made an effort to do better. The north wing started two days ahead of the south building, and the marks set up by the men on the north side drew corresponding speed from the men on the other side. The two mixers were placed side by side on the Winchester Avenue end of the buildings, so that the two concrete gangs worked from the same stock pile side by side.

A 50 per cent. increase in the amount of concrete laid in a day was striking testimony to the gain in labor efficiency that resulted largely from the competition. At the outset the casting of two bays length of floor the full width of the building was counted a good day's work. But towards the end of the job three bays were laid in eight hours. Part of this gain was no doubt chargeable to practice, but the spirit of the gain deserves most of the credit. The labor boss on the north wing had been with the Aberthaw Company for a long time, and has handled well the labor on the eight-story Baxter Building, at Portland, Me., when the company had built at the rate of a story per week. But neither on the Portland job, nor on other large work that he had handled successfully, had this foreman ever put in concrete so cheaply, or so great an amount per day, as on the New Haven job.

In computing the saving on labor costs due to this competition of working gangs, the basis of comparison is necessarily somewhat a matter of opinion. The Aberthaw Company adopted as a basis the unit labor costs per yard of concrete, per square foot of forms, and per ton of steel, in two other concrete buildings of about the same size as those at New Haven. Using this standard it appeared that the saving in labor costs on the New Haven job was 19 per cent. on the concrete labor, 5 per cent. on the labor on forms, and 22 per cent. on the labor on steel erection. The total saving on all labor items was 10.8 per cent. of the labor cost for the job as it would have been without competition, figured from the other buildings taken as standard work. In any such estimate there is, of course, room for differences of opinion because the labor cost in concrete buildings is so largely influenced by matters of design, and in estimating the weight to be assigned to such differences judges might not exactly agree. But with all reasonable allowances on this head it seems evident that by this competitive system the Aberthaw Company did get out of their New Haven job with an outlay for labor about 10 per cent. less than that outlay would have been without the rivalry between the working gangs. There was less than $400 difference in the labor cost of the two wings.

So far as the laborers were concerned the spirit of rivalry created an atmosphere of play which pervaded everything and lasted throughout the job. The concrete laborers were largely Italians, but they, as well as all the others, showed the keenest interest in the progress of the competition and went at their jobs day after day with all the zest of sport.

Carefully restrained and not pushed to the extreme which would lead to the evident mistake of over-hasty and imperfect concrete work, competition of this sort evidently has a considerable practical value, and gets from the laborer more work, and work done in a spirit of greater content and interest, than is otherwise possible. The superintendent in charge needs considerable tact in dealing with the workmen, and he needs to insist very rigidly on the best quality of work; but with all these complications the competitive system is evidently within limits a practicable way of raising the efficiency of labor and thus of cutting down the total labor cost of construction.

The present tendency toward the generation of steam in large units is being exemplified by the Detroit Edison Co., who have just purchased four 13-retort Taylor Stokers to be used with two 2,300 horse power Stirling boilers. This great output from a single boiler is secured by double firing with a stoker at each end, each boiler having a furnace 26 ft. by 15 ft. The Taylor Stoker was selected because of its great overload capacity. So far as known by the American Ship Windlass Company, manufacturers of the Taylor, these are the largest stokers in the world.

There is one feature of the activity now prevailing throughout the United States that insures permanent benefits to the country at large and to the various localities in which this form of progress is most in evidence. We refer to the past year of enlargement of the volume of building operations and to the very evident fact that 1910 is to be the record-breaking year in the building annals of the United States. There is not a single city of importance in the country but reports contracts closed, being prepared or in process of negotiation to a far greater number and value than ever before known. What is true of the cities is true of the towns, the villages and the rural districts of nearly all the states and territories.

PROBLEMS IN APPLIED STATICS.

T. R. Loudon, B.A.Sc.
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This series of problems began in the issue for the week, October 22nd, 1909. It is assumed that the reader either has an elementary knowledge of the subject of Statics, or is in a position to read some text on such theory.

The Equilibrium Polygon.

The Vector Polygon gives the magnitude, direction, and sense of the Resultant of a set of forces, but does not determine the true position of the line of action of this Resultant. The problem of locating the Resultant may be accomplished by means of what is termed the Equilibrium Polygon.

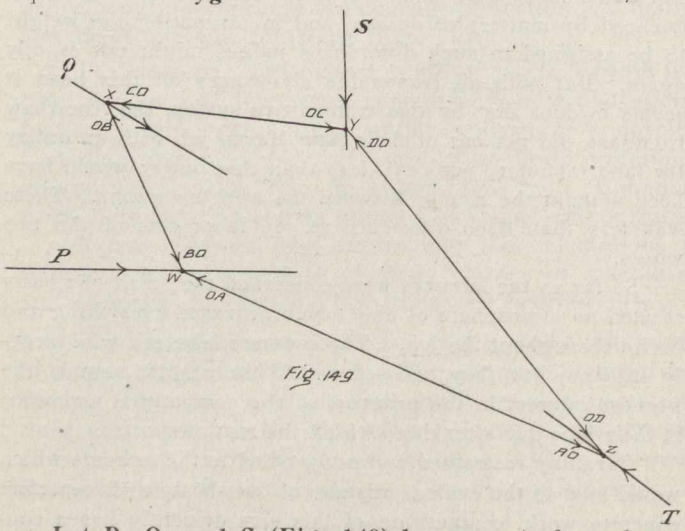


Fig. 149.

Let P, Q, and S (Fig. 149) be any set of co-planar forces, the Resultant of which it is required to locate.

In a previous discussion, it was shown that the size and shape of the body acted upon can in no way alter the position of the line of action of the Resultant and Equilibriant of a set of forces; in other words, **the Resultant and Equilibriant are independent of the size and shape of the body acted upon.** This being the case, it will be shown that the position of the Equilibriant and Resultant may be determined by replacing the original body by an unbraced, free-jointed frame, the shape of which will give the desired information.

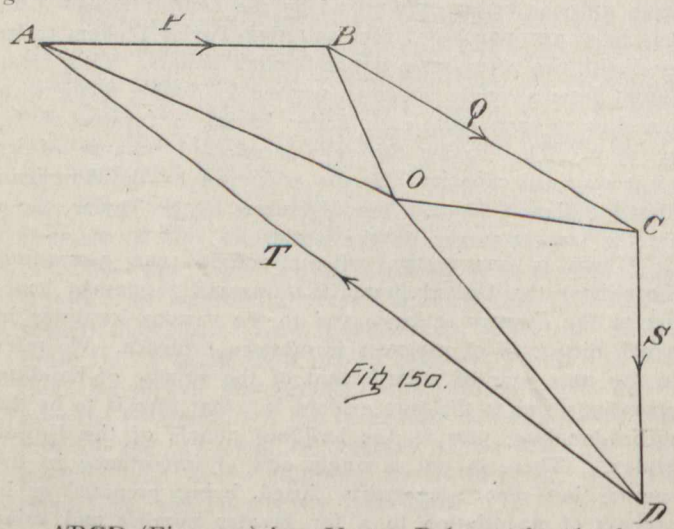


Fig. 150.

ABCD (Fig. 150) is a Vector Polygon for the forces P, Q and S. DA evidently represents the Balancing Force or Equilibriant of this set of forces.

It is evident that **if the Equilibriant can be located, the position of the Resultant will also be known,** for the Equilibriant and Resultant of a set of forces have the same lines of action.

Choose any point O in Fig. 150 and join it to A, B, C, and D; i.e., to the terminations of the lines composing the Vector Polygon.

It is evident, from Fig. 150, that since the lines AB, BO, and OA form a closed polygon, the three forces represented by these lines will be in equilibrium, provided their lines of action intersect at a common point. If these three forces are in equilibrium, such a condition of affairs could be expressed by saying that any two of the forces balance the third. For instance, the forces BO and OA may balance the force AB; i.e, balance the force P.

At any point W on the line of action of P (Fig. 149) introduce the forces OA and BO. These three forces are in equilibrium.

For the time being, any discussion as to how these forces OA and BO are exerted and what constitutes the body acted upon by the three forces, P, BO, and OA, will be dropped.

Produce the line of action of BO to intersect the line of action of Q at X, and at this point introduce the forces represented by CO and OB (Fig. 150). The line of action of OB evidently coincides with BO (Fig. 149). It is seen from a consideration of the triangle BCO (Fig. 150) that the forces OB and CO acting at X (Fig. 149) will balance the force Q.

Produce the line of action of CO to intersect the line of action of S at Y. At Y introduce the forces DO and OC represented by the lines DO and OC (Fig. 150). These forces balance the force S.

Produce the line of action of DO to intersect at Z the line of action of OA produced, and at Z introduce two forces, AO and OD, represented by AO and OD (Fig. 150).

Let the polygon WXYZ (Fig. 149) represent a frame having pin joints at W, X, Y, and Z. It is evident that the frame will be in equilibrium if some force be introduced at Z which will balance AO and OD. The force T, represented by DA (Fig. 150) evidently fulfils this condition.

Thus, it is seen that under the action of the forces P, Q, S, and T the frame is held in equilibrium, and since a given set of forces to be in equilibrium can only act, relatively to one another, in certain definite lines, the force T, the Equilibriant of P, Q, and S, has been located.

It is estimated that 115,000 automobiles were made in the United States last year. At an average of $2,000 the total value of these would be $230,000.000. This output is astonishing when it is remembered that the output of such cars was only 11,000 in 1903 and 30,100 in 1906. There were imported into the United States last year 1,645 cars, valued at $3,071,000 and exported 3,686 cars valued at $6,890,000. The exports have greatly increased during the past four years, while the imports have shown a decline. Imports showed 928 cars from France, 418 from Italy, 127 from Germany and 101 from England. The cars exported went to all the corners of the earth, to Africa, East India and to Australia, as well as to Canada, Europe and South America. Exports to the United Kingdom were valued at $2,000,000, to Canada at $2,400,000, to France at $846,000, to Mexico at $494,000, to South America at $240,000, to British Australasia at $303,000, and to Africa at $49,000

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

HYDROPHOBIA.

Although the subject of hydrophobia does not come under any of our headings of Sewerage, Sewage Disposal and Water Purification, we may be excused for saying something on the subject in view of the present interest taken in the Ontario Provincial muzzling order.

The exciting cause of rabies is supposed to be a poison whose probable source is a vegetable organism, although the specific germ has not been isolated. Pasteur, Chamberland and Roux all made most careful search for organisms in the various tissues of animals affected by hydrophobia, and, although they at first imagined that they had been successful, they eventually concluded that the small, round micrococcus-like bodies that they found were not associated with the disease.

It was very early demonstrated that rabies does not arise spontaneously, but that each case could be traced to a specific date of implantation. With the human subject the outbreak always bears a definite relation to the bite of a rabid dog, wolf, or cat, or it might be to the licking of an abraided surface by a perfectly healthy animal, which afterwards developed symptoms of hydrophobia.

Although the disease is commonly associated with dogs, wolves and cats, it has been observed that rabbits, deer, guinea-pigs, and even horses may be similarly affected.

It was not until 1880 that Pasteur set himself to study the virus of this terrible disease. He took a little of the saliva from a child in whom the disease was developing as the result of a bite of a mad dog. A rabbit died in two days after being inoculated with this saliva under the skin. The saliva from this animal produced the same result with another rabbit treated in a like manner.

The fact that the symptoms of hydrophobia, especially in the latter stages, are very similar to tetanus have led many people to believe that the bite is not the actual cause of the disease, but that the septic poisoning is an after contact from outside poison.

After the bite there may be no symptoms for a month or six weeks, or even for twelve months. This is known as the period of incubation. The first symptoms are merely those of discomfort and itching, succeeded by intolerable heat, accompanied by stinging pain. On the second or third day the patient becomes excited, followed by rambling delirium. Muscular tremors are then noted similar to those in tetanus. Finally, the patient dies of suffocation.

Pasteur's treatment consists in obtaining an attenuated or weakened virus. It is known that the virus or poison of certain diseases become gradually weaker after successive struggles with the protective properties in animal tissues.

Inoculation of this attenuated virus, if applied in time, appears to prepare the system to successfully combat the more virulent virus. The highly organized cells of the nervous system are, as it were, acclimatized to the presence of the stronger poison.

Pasteur obtained inoculation material of various degrees of virulence with which he inoculated twenty dogs, three-quarters of the number being found protected from virulent hydrophobia. The first series of experiments were an extraordinary success, and eventually the results he obtained were even more remarkable.

On the 26th of October, 1885, Pasteur described his method to the French Academy of Sciences. He showed that by inoculating animals on ten successive days, commencing with the weakest virus, and continuing until he had used an emulsion from a cord that had been exposed only two or three days to the dried air, they were protected against hydrophobia, even when extremely virulent virus was afterwards injected into the membranes of the brain. Of fifty dogs so treated, everyone was refractory to the disease in proportion to the theoretical degree of protection given.

The first human being inoculated against hydrophobia was a boy, Joseph Meister, aged nine, who was bitten by a mad dog on July 4th, 1885. Pasteur resolved, after consultation with Professors Vulpiau and Grancher, who agreed to share the responsibility, to treat the boy as he had treated the dogs.

During the following ten days he made thirteen injections of attenuated virus, when on the tenth day the boy was inoculated with a virulent virus from a rabbit which had died on the same day. The boy never developed the slightest symptoms of hydrophobia.

One of the most convincing proofs of the efficacy of this system of inoculation is given by Babes. Thirteen men and thirty animals—cattle, horses, pigs and dogs—were attacked by rabid wolves; of the thirteen men so attacked, twelve came to Bucharest for treatment, and all of them recovered except one, whose head was fearfully torn and lacerated by the fangs of a wolf. The thirteenth man, who would not present himself for treatment, died of hydrophobia. Another significant fact was that every one of the thirty animals succumbed to typical hydrophobia.

That such a specific disease as hydrophobia exists, that it is always fatal if not attended to, are facts which are undeniable. Those who know anything of the disease and have followed the history of outbreaks and its method of transmission, have not the slightest hesitation in backing up the Government in any drastic measures they may think fit to take to reduce the risk of transmission.

THE DISINFECTION OF SEWAGE AND SEWAGE FILTER EFFLUENTS.*

By Earle Bernard Phelps.

Review by T. Aird Murray, C.E.

Previous chapter in last week's issue dealt with evidence of pathogenic germs in sewage and sewage effluents from various methods of treatment. The necessity for disinfection and classification of methods of disinfection.

Chapter II.—Experimental Investigations.

Early in 1906 an arrangement between the Massachusetts Institute of Technology and United States Geological Survey, made it possible to go thoroughly into the question of disinfection of sewage by the use of chemicals. The experimental work was carried out at Boston, Red Bank, N.J., and at Baltimore.

The method employed by the author in expressing results is very satisfactory. General averages are very apt to be misleading. It is commonly said that "a chain is just as strong as its weakest link." In presenting averages which cover long periods it is quite possible that the weak links in the chain may be overlooked. To obtain an intelligent knowledge of the real value of disinfection, extreme deviations from the average should receive consideration. The routine work is reported in the form of weekly averages, and individual variations from the average bacterial removal are also given.

Such a system is highly commendable, and it would be well if it were more generally used in expressing results in water filtration. We know of cases where annual average bacterial removals are given which appear highly satisfactory, but which take no note of periodical breakdowns, the few days of low efficiency figures being swallowed up in the greater number of higher efficiency figures, producing generally what appear as most satisfactory results, yet taking no cognizance of periods when highly infected water was being produced. The real information required is what was actually accomplished, when the plant was working at its lowest efficiency; this information may then be compared with general efficiency.

The preliminary experiments were made in order to be able to define practical working limits with reference to efficiency and cost. It is shown that complete sterilization is practically an impossibility. It is for this reason that the term "disinfection" is used rather than the term "sterilization." The well known fact is pointed out, that it is easy to kill the first 95 per cent. of the bacteria, and very difficult to destroy the remaining "resistant minority" as Whipple terms it. This applies to all methods of disinfection. The author states a concrete example as follows: "It might happen that the pathogenicity of an effluent could be reduced 96 per cent. by the expenditure of a certain sum of money, 97 per cent. by the expenditure of twice that sum, and 99 per cent. by the expenditure of five times that sum. The first reduction might represent a feasible plan, and the last a prohibitively expensive one."

The Boston experiments were carried out more particularly with reference to disinfecting effluents from percolating filters. Two filters were used each of an area of 50 square feet by 8 feet deep. The combined filter capacity being equal to about 30 cubic yards of rough stone varying from once inch to two inches in diameter. The rate of flow was 5,000 gallons of sewage per twenty-four hours or one hundred and sixty-six gallons of sewage per cubic yard of filter. The effluents from the filters passed into a Dörtmund tank of a capacity equal to a flow of 200 gallons per hour. The chlorine solution was fed from an orifice box direct into the effluent flowing into the Dörtmund tank.

Results of experiments are given with various degrees of strength of available chlorine, over a period from November 12th, 1907 to June 27th, 1908. Thus results under fluctuating conditions of temperature are obtained.

During the first five weeks about six parts per million of available chlorine was used, and during the remainder of the period from two to four parts. The remarkable feature of the tests lies in the fact that the reduction in the amount of disinfectant used did not materially effect the results. The results also show that variation in temperature has no appreciable effect on disinfection.

The average reduction in B. coli throughout the whole period was 99.19 per cent. From November 12 to December 12, during which period 6.3 parts per 1,000,000 of available chlorine was being used, the reduction of B. coli averaged 99.99 per cent. January 27 to March 28, during which period 3.2 parts per 1,000,000 of available chlorine was being used, the reduction of B. coli averaged 98.5 per cent. From April 27 to June 27 when slightly over two parts per 1,000,000 of available chlorine was being used, the reduction of B. coli averaged 99.07 per cent.

A consideration of the B. coli removal from November to December of 99.99 per cent., with 6.3 parts of chlorine used, compared with the removal 98.5 per cent. from January to March with 3.2 parts of chlorine, is illustrative of the excessive increase of chlorine required to obtain only slightly improved results.

An interesting feature in the above results with reference to temperature having little or no effect on chlorine processes, lies in the fact which has been clearly demonstrated that concentrations of sulphate of copper must be doubled during winter months in order to maintain efficiency.

The reliability of the above tests, however, depends upon its weakest or poorest results. Phelps presents a table which shows that with individual tests over half the number resulted in removals of from 98 per cent. to 100 per cent., while only 15 per cent. of the total number of tests resulted in less than 94 per cent. removals. The weakest links in the whole chain showing 2 per cent. of the tests with results not greater than 75 per cent. removal and not less than 65 per cent. removal.

Experiments were also carried out at Boston in order to determine the length of time necessary for contact of the disinfectant with the sewage. Samples were taken of the percolating filter effluents after the disinfectant had been added, these being allowed to stand ten minutes, fifteen minutes, one hour, and two hours. The experiments covered a period from August 6th to August 23rd with available chlorine added in parts of 5 per million. The percentage of bacteria remaining after the above periods of contact were as follows: In ten minutes 5 per cent., in fifteen minutes 0.17 per cent., in sixty minutes 0.10 per cent., in one hundred and twenty minutes 0.07 per cent.

The above points to a contact of about an hour, as being the period producing a practical efficiency. Little is gained by extending the period to two hours.

It should be noted that the above results include any sediment, so that no allowance is necessary for bacteria which may have been removed by precipitation.

Phelps concludes that "these results demonstrate the entire feasibility of satisfactorily disinfecting trickling filter effluents with chloride of lime, and they indicate that about 3.5 parts per million of available chlorine and a contact

*Published in contributions from the Sanitary Research Laboratory and Sewage Experiment Station, Vol. V.

period of about an hour is ample for an effluent like that on which the experiments were made."

A chemical analysis of the effluent from the filters on which the disinfecting experiments were made shows it to be non-putrescible. In parts of 1,000,000 the total suspended solids were 213, while nitrogen was represented as follows: Total organic 8.0; free ammonia 14.0; nitrites .4; nitrates 4.0; oxygen consumed (thirty minute boiling method); total 50.00; dissolved oxygen 8.8.

After the disinfecting process the effluent showed a further removal of putrescibility in the oxygen consumed figure, and a further removal of suspended solids in the Dörtmund tank. The final chemical analysis shows total suspended solids 124; while nitrogen was represented as follows: Total organic 5.0; free ammonia 13.5; nitrites 0.5; nitrates 4.0; oxygen consumed (total) 41.00.

We therefore see that apart from the question of disinfection a chemical improvement has also been brought about in the effluent.

Disinfection of Crude Sewage.

Phelps has to state with reference to crude Boston sewage as follows: Satisfactory disinfection of crude Boston sewage can be accomplished by adding chloride of lime in such amounts that the available chlorine will amount to about five parts per million during six months in the year, and to between five and ten parts during the other six months, or an average amount during the year of seven or eight parts per million. The addition of the disinfectant in portions at intervals during the treatment yields results that are somewhat better than those obtained by adding the entire amount at once, but it is not probable that this advantage is commensurate with the additional complications involved."

The above conclusions are sustained by two sets of experiments. In the first set there were two series, in one of which 10 parts per million of chlorine were added at the start of a contact period of two hours, resulting in a 99.76 per cent. reduction of total bacteria; in the other series the application of the ten parts of chlorine was divided into four doses over a four hours contact period; the reduction of bacteria in two hours was 98.3 per cent., and in four hours 99.96 per cent. The increased efficiency by intermittent dosing of the disinfectant is not great, and as Phelps points out, "it is doubtful whether it would generally be sufficient to compensate for the more complicated method of operation."

The second set of experiments were made to determine the minimum amount of chlorine and time contact required for satisfactory disinfection of crude sewage. A two hour period of contact was given and samples taken after half an hour, one hour, and two hour periods. Chlorine was added in parts per a million of from two to ten.

The results indicate that a large amount of chlorine is consumed by the sewage within two hours. A summary of the results with reference to bacteria removal proves as follows. Available chlorine in parts per 1,000,000: Two removes 85 per cent.; four removes 98.7 per cent.; six removes 99.7 per cent.; eight removes 99.94 per cent.; ten removes 99.96 per cent.

It will very seldom be necessary to apply disinfection to crude sewage. First, because of the great cost, and secondly because, although the crude sewage may be disinfected, the organic matter still remaining is subject to putrefaction causing a nuisance at the location of discharge. Disinfection delays the natural processes of putrefaction only for a time; therefore, it is recognized that in any case which does not allow of great dilution, such as a seaboard, the removal of the tendency to putrescibility must be the first process in sewage disposal methods. Phelps fully recognizes this point, and plainly shows that in the case of dealing with crude sewage, the greater proportion of the chlorine used is absorbed by the suspended organic matter present, before it has any opportunity of exerting any disinfecting influence.

So much then for the results obtained at Boston, it will be interesting to see how they compare with German results.

Boston Experiments Compared With German.

Professor Dunbar, of Hamburg, has to state with reference to his own experiments, "one fact may, however, be regarded as certain, viz., that none of the disinfectants suggested for the disinfection of sewage can approach chloride of lime, as regards lowness of cost." Further, that "chloride of lime in a concentration of 1 in 15,000, or 1 in 10,000, is more efficacious than lime in a concentration of 1 in 500.

Most of the German experiments in disinfection have been carried out either in connection with crude sewage or merely settled sewage; and most of the data refer to the penetrating power of certain concentrations on solids. Dunbar agrees with Phelps in the conclusion that the oxygen absorbed figure has much to do with the quantity of chloride of lime required. He states: "Our experiments have confirmed the view, that generally the more concentrated the sewage, i.e., the greater its oxygen absorbed figure, the more chloride of lime is necessary for its disinfection."

The following disinfection results were obtained by Schwarz by the use of chlorine in various forms of concentration. Crude sewage containing 1,350,000 bacteria per c.c. Chloride of lime added in the following concentrations produced percentage removals of bacteria per c.c.:—

	Bacterial Removal
1 in 2,000	99.999 per cent.
1 in 6,000	99.997 "
1 in 10,000	99.990 "
1 in 20,000	99.98 "
1 in 30,000	99.7 "
1 in 40,000	95.6 "

From the above, the weakest concentration used amounts to 25 parts in 1,000,000, and this with four hours contact only removed 95.6 per cent. bacteria per c.c. from crude sewage.

Dunbar in commenting on the above results states: "It appears for all practical purposes it is sufficient to add chloride of lime 1 in 5,000 to ordinary sewage, and to allow its action to continue for two hours, in order to destroy the germs of typhoid, dysentery, cholera, and pathogenic germs of similar sensitiveness."

One in 5,000, which means 200 parts per 1,000,000, brings us face to face with a different conclusion from that of Phelps of from 7 to 10 parts of chlorine per 1,000,000. In fact, it must be acknowledged, that Phelps has apparently revolutionized the whole standard of amounts of chlorine required for the disinfection of crude sewage.

Schwarz also conducted chlorine disinfecting experiments in connection with one of the Hamburg settling tank effluents, the tank capacity being equal to four hours flow. When 1 c.c. samples were examined B. coli could not be detected after the addition of chloride of lime 1 in 10,000 and 1 in 20,000. B. coli was, however, found in three out of seventeen litre samples, after the addition of chloride of lime 1 in 2,000.

We find that the whole of Phelps experiments are based upon a somewhat different hypothesis from that of the German experiments.

The Germans appear to have aimed at sterilization; on the other hand Phelps aims at practical disinfection. His view appears to be, in order to obtain a fair idea of the com-

parative cost of disinfection as compared with other methods of supplementary treatment of sewage for bacterial removal, we should look only for efficiencies of a like standard obtainable by such supplementary methods, such as sand filtration, etc.

(To Be Continued.)

REINFORCED CONCRETE SIPHONS ACROSS SOSA RIVER AND CANYON OF RIBABONA.

By Professor B. A. Etcheverry.*

This siphon is interesting because of the magnitude of the work and the method of construction to make the conduit impermeable. Before its construction the use of reinforced concrete for pressure pipes had been largely confined to pipes of comparatively small diameter, built mostly in Europe and rarely exceeding six feet in diameter. In many cases the impermeability of good concrete has been relied upon where the pressure head is as great as 100 feet and a French firm has by using a special metal shell, either as a lining or imbedded in the concrete, constructed many miles of reinforced concrete pipes for pressures as great as 300 feet and above; this form of construction was adopted for the Sosa Siphon.

While there are many reinforced concrete pressure pipes in Europe which were built fifteen to twenty years ago, it is only recently that they have been used in the United States. Their use in irrigation work has been largely limited to siphons built by the Reclamation Service. A notable example is a siphon built on the Umatilla project, Oregon. The siphon is 4,680 feet long, 47 inches inside diameter, 2½ inches thick, and under a maximum pressure head of 55 feet. The pipe is reinforced with a coil of 5-16 inch steel wire computed for a tensile stress of 12,000 pounds per square inch. This pipe has given entire satisfaction during two seasons.

The largest reinforced concrete pressure pipe in existence before the one to be described, was one built for a Hydro-electric plant at Champ, Isere (France). This pipe is 6,888 feet long, 10.82 feet in inside diameter with a thickness of reinforced concrete shell varying from 7.9 to 9.8 inches, depending on the pressure head, which is 65.6 feet as a maximum. The pipe is reinforced with a metal skeleton consisting of hoops made of round rods and of longitudinal rods, forming about a four inch mesh. As this pressure pipe was of smaller diameter and subjected to a smaller pressure than the contemplated Sosa Siphon, it was decided that the Sosa Siphon would be built with a steel shell imbedded in the reinforced concrete, to insure the water tightness of the pipe.

The Sosa Siphon, constructed for the irrigation system of Aragon & Catalogne (Spain), consists of two reinforced concrete conduits, 12.17 feet inside diameter, 3,340 feet long, and subject to a maximum head of 85 feet, with a flow through the twin pipes of 1,236 second feet. The siphon crosses two depressions, which divide it in two almost equal parts. (Fig. 1). It passes over the River Sosa at the foot of the first depression on a splendid concrete bridge 590 feet long and crosses the Ribabona Canyon at the foot of the second depression on a smaller bridge. At the lowest point of each depression, blow off valves 1.64 feet in diameter were constructed. Between these two depressions the siphon rises nearly to the hydraulic grade line and at this summit is a set of piezometers or air vents, 8.20 feet in diameter and 8.86 feet high. Automatic air vents were also installed at the first elbow of each depression.

While the original specifications required an auxiliary pipe system to fill the siphons without producing water hammer, this was not considered necessary because of the large diameter of the pipes and was therefore omitted.

When the construction was completed the conduits were covered with earth to reduce the effects due to changes in temperature.

The construction of this siphon, the largest in the world, was opened to international competition and of the several propositions presented, the one accepted was that of the firm directed to Senior D. J. Eugenio Ribera, and Mr. Aime Bonna of France, a specialist in the construction of reinforced concrete pipe, was consulting engineer. While Mr. Bonna directed the beginning of the construction, Mr. M. Mariano Luina engineer in charge deserves the credit for the successful handling and completion of this undertaking.

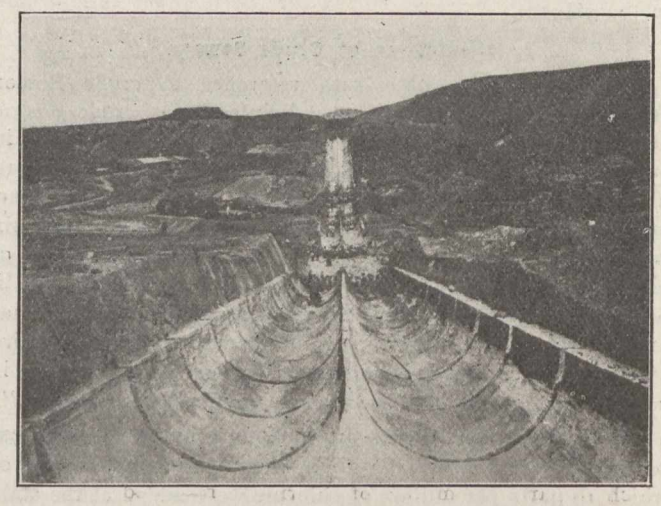


Plate 1. Concrete Cradles to Support Conduits.

The project has been very fully described by Mr. Luina in seven numbers of the "Revista de Las Obras Publicas" and reviewed in Le Genie Civil. From these papers the description following has been obtained.

Description of Conduits.

The conduits are built on a concrete bed or cradle which supports them up to the horizontal diameter. (Plate 1). The conduits are 6.89 inches thick, the shell consisting of an interior lining of reinforced concrete 87 inches thick applied on a steel tube .118 inches thick and an outside reinforced concrete covering 5.90 inches thick.

The interior concrete lining and outside concrete shell protect from oxidation the imbedded iron tube intended to prevent percolation. The main resisting part is the outside shell which is reinforced with iron T shapes part round, for circular reinforcement; the percentage of reinforcements varying according to the pressure. The steel shell has a uniform thickness throughout and it was assumed that only one-half of the thickness of the shell was to resist any stress. The inside lining has a uniform reinforcement throughout.

The conduits were not built monolithic but in sections 21.32 feet long. To connect the sections together the iron tubes were joined by means of special iron collars which permit expansion and contraction. The joint was then coated with an asphalt mixture and completed with a ring of reinforced concrete.

To assure water tightness, it was attempted at first to weld together all parts of the steel tube as well as the joints.

*In the California Journal of Technology.

For this purpose a plant was installed to generate hydrogen and oxygen by the decomposition of river water. This method had to be abandoned because of the slowness of the work which allowed the welding of only two tubes a day, when eight were necessary to not delay the remainder of the work. For this reason and also because of the difficulties experienced, riveting was submitted for welding. From this time on the construction work was carried on with great activity.

Supporting Cradles. (Fig. 2.)

These cradles were made in sections 19.7 feet long and separated by intervals 1.64 feet wide (Plate 1) to permit the passage of the workingmen and give working space when constructing the pipe and making the joints. To construct the cradles a gang of twenty men laid the lower part of the concrete up to A-A (Fig 2) which required no forms, and averaged about 38 cubic yards a day. This gang was followed by a crew of carpenters who placed the lower parts of the forms together. These forms consisted of two circular parts, a triangula part for the interior gallery and 4 parts for the sides of the cradle resting on the lower circular parts and put in position after the placing of concrete in the lower part. The carpenters were followed by two crews of 30 concrete men each, one crew on each side of the river. Each crew placed 43 cubic yards of concrete or two sections of cradle per day. The total number of cradles is 158. Over the two bridges, these cradles have a special shape. The remaining cradles rest on the natural earth in a trench 16 1-3 feet wide at the bottom, with side slopes of 1 to 2.2.

Steel Shell.

These tubes are .118 inches thick and were constructed in sections 21.32 feet long. Each tube was made of 5 circular sections or cylinders 4.264 feet long and each cylinder consisted of 4 sheets 10.10 feet x 4.43 feet x 118 inches. A tube when completed weighed 2,000 pounds. After it was discovered that the process of welding was too slow, all parts of the tube were put together by riveting. All changes in slopes were made by cutting the abutting ends of the tubes to make them fit.

Exterior Enforcement.

The reinforcement consists of a series of hoops made of T bars; the spacing of these bars varying with the pressure. The siphon was divided in four zones, corresponding to pressures of 33 feet, 49 feet, 65 feet and those exceeding 65 feet. These hoops were made in one piece and their ends fastened with cover plates and rivets. The drilling of holes and bending of bars was done at two installations, one near the Sosa, the other near the Ribabona. These hoops were slipped on the iron tubes and spaced according to pressure. For the sections receiving the greatest pressures, 52 hoops 1.77 x 1.77 x .236 inches were used. To hold the hoops in position they were tied with wire to 80 longitudinal rods .315 inches in diameter and 20.84 feet long, previously introduced between the steel shell and the hoops. To place the reinforcement the tube was rolled on two timbers about 5 inches high placed about 5 feet from each end of the tube and the hoops slipped around the two ends; then the tube is rolled on two other timbers placed near its extremities and a little higher, so that the first two timbers may be removed, and the hoops given the proper spacing and tied to the longitudinal rods which had been previously inserted.

Transportation of Reinforced Tubes.

To transport the tubes with the hoops in place a track was laid, running from the manufacturing plant to the pipe line and inside the cradles. To carry the tubes cars were built with an inverted circular bottom of the size of the tube. These cars travelled on the track to the base of the siphons, and from there hauled by cable on the track inside the cradle. the tubes being laid from the top of the siphon down to the base.

Placing Steel Tubes in Position.

To place the tube in position on its supporting cradle it was lifted from the car by means of a rolling derrick. When lifted from its car, the car was run down to the base of the siphon; the track under the tube was removed and the tube placed in position 2 inches from the adjacent tube and supported at its two extremities with 5 blocks at each end and spaced on the cradle to give the necessary thickness of reinforced concrete shell of 5.9 inches between the steel tube and concrete cradles.

Concrete Work. (Fig. 3). (Plate 2.)

The placing of concrete between the tube and the cradle was a very simple operation except for the extremities of the tube extending into the space between the cradles. Here it was necessary to leave a groove around the pipe wide enough to place the steel collar joining the tubes, and also to prevent the concrete from flowing in the interval between cradles, which it was necessary to keep open to give working space when making the joint. To construct this part, the cradle was continued by a semi-circular plate ⅛ inch thick, 10 inches wide, surrounding the lower half of the conduit and semi-circular wooden dams were placed at the two extremities between the metal plate and the steel tube to prevent the escape of the concrete. The upper part of the mold consisted of a set of wooden circular ribbed panels placed with their ends

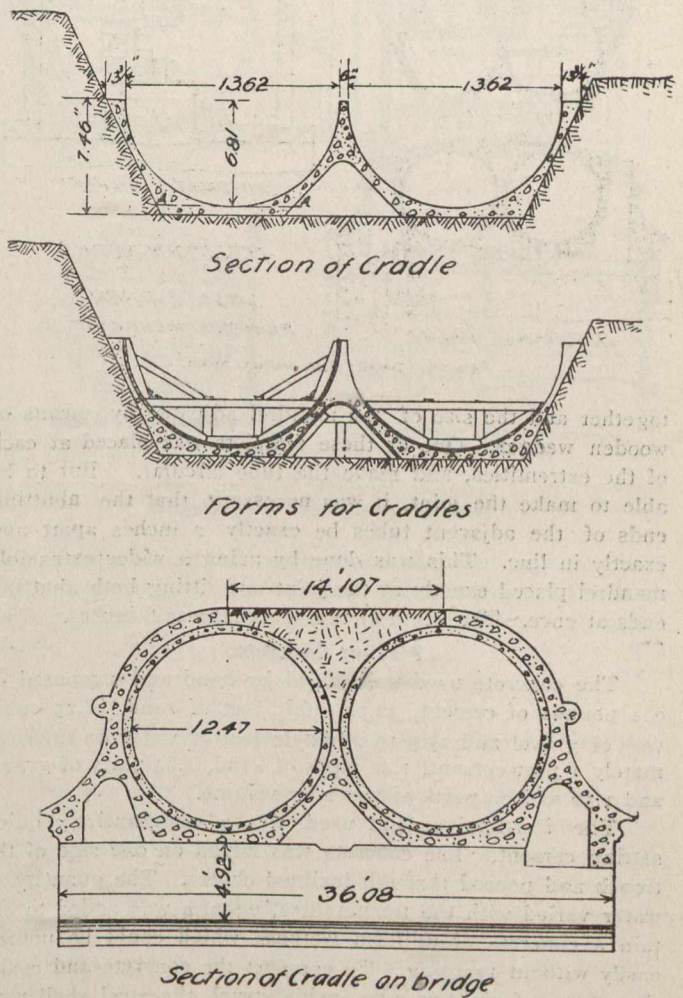


Fig. 2.—Cradle for Rio Sosa Siphon, Spain.

supported on the semi-circular wooden dams surrounding the upper part of the pipe at both ends. The panel forms were built up as the concrete was poured in and the ribs tied to the reinforcement with wire.

Reshaping of Steel Tubes.

Because of the thinness of the steel shell the tubes were all more or less deformed. The lower parts being supported at the extremities when placed in the cradle, retained their shape but the upper half had to be reshaped. For this an extensible wooden mandrel composed of 4 parts or quadrants were used. (Fig. 3). The opposite quadrants were fastened

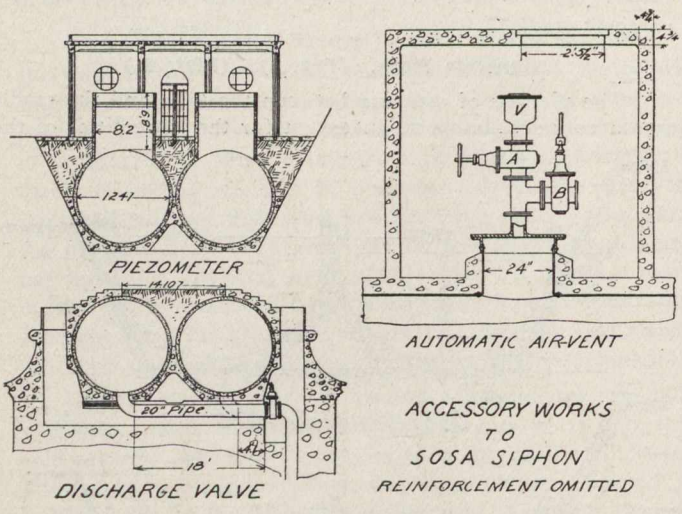


Fig. 3. Details Sosa Siphon, Spain.

together and the size of the mandrel adjusted by means of wooden wedges. One of these templets was placed at each of the extremities, and made the tube circular. But to be able to make the joint, it was necessary that the abutting ends of the adjacent tubes be exactly 2 inches apart and exactly in line. This was done by using a wider extensible mandrel placed exactly at the joint and fitting both abutting ends at once. The width of this mandrel was 6 inches.

Placing Concrete.

The concrete used was mixed by hand and composed of 922 pounds of cement, 14.12 cubic feet of sand, 28.25 cubic feet of gravel and 15.5 to 20 cubic feet of water on approximately 1 part cement, 1.42 parts of sand, 2.84 parts of gravel and 1.56 to 2.00 parts of water by volume.

The Portland cement used was a comparatively quick setting cement. The concrete was mixed on one side of the trench and poured through inclined chutes. The quantity of water varied with the temperature, enough was added to obtain a concrete of uniform wetness which could be poured easily without tamping. To compact the concrete and assist the escape of air, two men inside struck the steel shell with wooden mallets. At the end of two hours the concrete had set sufficiently to allow the removal of the forms. To prevent the floating of the tube while filling the lower part with the wet concrete, several sections of tubes were fitted together at the joints with the extensible templets described above.

Making of Joints.

The joints were made after a large section of the concreting of the tubes had been made. When the outside concreting was completed it left a groove 6.3 inches wide, between the adjacent ends of the concrete shell and in this groove the abutting end of the steel tubes were 2 inches apart. To make the joint, the circumferential steel ring with semi-circular cross section was placed in position to mark the position of rivet holes. After these holes were drilled this ring was bolted or riveted to the steel tubes. On top of this joint were applied several layers of a hot mixture consisting of 80 to 85 per cent. coal tar and 15 to 20 per cent. asphalt. For the first conduit the steel rings were bolted on the tubes as it was anticipated that riveting would destroy the bond between the concrete and the tube. For the second conduit riveting was used very successfully. After applying the elastic mixture a reinforced concrete ring was made over the joint and extended well over the two ends of the concrete shell. To make this ring, the reinforcement was placed around the pipe and held the proper distance away from the concrete shell by spacing blocks; then the concrete was placed by means of a special mould consisting of a metal plate fastened to two circular wooden templets about 15¾ inches apart and braced across with wooden strips, which were used as steps by the workmen.

Interior Lining.

The interior lining consists of a reinforced concrete shell .87 inches thick, intended to protect the steel tube from corrosion. Reinforcement was used to facilitate the application of the mortar and consisted of a metallic cloth made up of wire 5/32 of an inch in diameter with the circumferential wire spaced 4 inches apart and the longitudinal wires 6 inches apart. The metallic cloth was made in sheets 20.4 ft. long and 5.25 to 6.51 ft. wide; 2 sheets covered the interior of the tube for 5.25 or 6.50 feet of its length. One sheet was used for the lower half of the tube and the other for the upper half.

The lower sheet was laid and the cement mortar spread and applied up to the horizontal diameter. The mortar used was composed of 1 part quick-setting cement, 2 parts Portland cement, and 8 parts of sand. The upper sheet was next placed in position and held in place by a temporary frame and cemented by two bands of quick-setting cement applied parallel with the axis of the tube about 4 to 6 inches wide and ¼ to ⅜ inch thick; then the temporary frame was removed and the cement mortar applied. For the lining of this upper half it was found that Portland cement could not be used because it did not set rapidly enough to adhere to the roof of the tube, and it was found necessary to use a mixture of

Plate 2.—Placing Concrete.

2 parts of quick-setting cement to 1 part of Portland cement and 8 parts of sand, which gave excellent results.

During the process of construction the lining was finished with a coat of pure cement 1/16 to ⅛ of an inch thick.

Finishing Conduits on Bridge (Pl. 3.)

After the interior lining the next step in the construction was the finishing of conduits supported on the bridge, which required complicated forms and careful work.

Accessory Works.

At the summit which separates the Sosa from the Ribabona, the hydraulic grade line passes very little above the conduits. Here piezometers were installed to allow the discharge of air which collects at this summit and for the protection against water hammer. They consist of vertical pipes 8.2 feet in diameter and 8.9 feet high, opened at the top and extending 15 inches above the water level. They were constructed of reinforced concrete, the method of construction and reinforcement being similar to that of the conduits. They are enclosed in a small reinforced concrete house.

Air Vents.

Although there are no other summits where air may accumulate, two sets of air vents were established, one just below the elbow before crossing the Sosa bridge and the other before the Ribabona bridge. Each vent consists of a short reinforced concrete tube 2 feet in diameter, reinforced with T bars and an iron lining riveted to the iron shell of the pipe, and terminating at the upper end with an iron flange to which are fastened the automatic air vent system. (Fig. 4.) If the automatic air vent V does not operate ,the cut-off gate valve A may be closed and the discharge gate valve B opened.

These are used in the lowest points of the two branches of the siphon to flush out the silt in the conduit and to draw out the water for necessary repairs.

These blow-offs consist of pipes 20 inches in diameter connected to the bottom of the conduits through an elbow and leading the water to some convenient point, the discharge being regulated by valves. (Fig. 4.) The discharge pipes consist of a steel tube ⅛ inch thick surrounded with spiral reinforcement of round rods 5/16 inch diameter imbedded in 2.4 inches of concrete.

Earth Covering.

To protect the conduit from changes in temperature it was covered over all of its length, except over the bridges, with an earth fill which forms a roadway 21.6 feet wide.

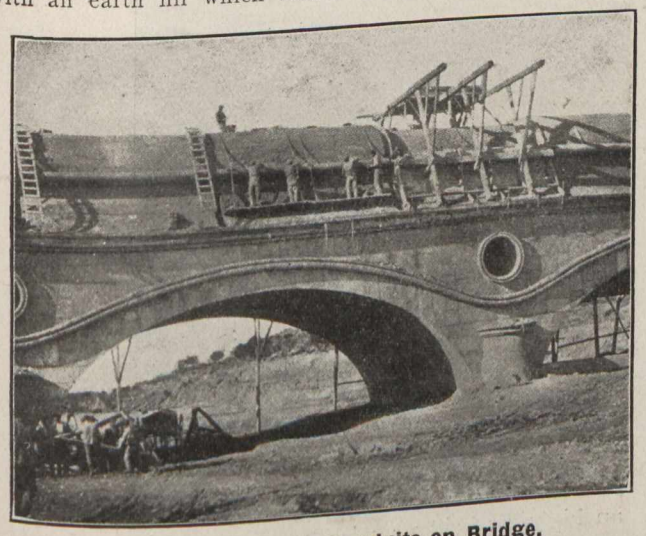


Plate 3.—Concreting Conduits on Bridge.

Over the bridges only the hollow or groove between the two pipes is filled in. Drains were provided to remove the water percolating through the soil.

Inlet and Outlet.

The inlet and outlet were excavated in rock forming a basin closed with a retaining wall in which the ends of the conduits are imbedded. The inlet chamber is divided into two compartments, the entrance being regulated by four openings controlled with gates. The depth of water in the inlet box is over 26 feet. The outlet box is similar to the inlet.

Sosa Bridge.

The Sosa bridge was not built under this contract. It is 590 feet long, 36 feet wide, and consists of 5 main elliptical arches of 49 feet span, and 10 smaller arches of 10 feet span. It required 13,000 cubic yards of concrete and cost about $86,000.

The concrete work on the conduit was started on the 10th of April, 1905, but the bulk of the placing of concrete was after the 13th of July. The conduit was completed on the 15th of December, 1905, and has been in successful operation since then. The total contract cost of the siphon and its accessory (excepting the bridges) was about $300,000. The cradles contain 6,540 cubic yards of concrete, requiring about

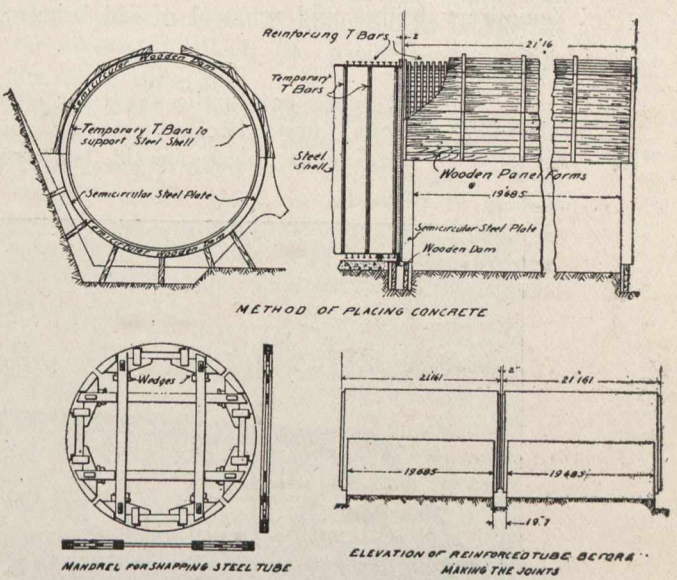


Fig. 4.

Blow-offs or Discharge Valves.

5,800 barrels of natural cement, and the twin pipes contain 5,230 cubic yards of concrete and 13,000 barrels of Portland cement. The amount of steel used was about 3,500,000 pounds.

THE ENGINEER AS MUNICIPAL REFORMER

The value of the engineer as a municipal reformer is getting a somewhat amusing, though also an instructive illustration at the hands of the new mayor of Boston. Mayor Fitzgerald captured the administration of the "reformed" city charter from the reformers, and he now takes an unusual course of action by putting in force one of the recommendations of the late Finance Commission. which he himself appointed two years ago, and of whose criticisms he was the most conspicuous target. Metcalf and Eddy, consulting engineers to the Finance Commission, in one of their many reports took up the waste of water by the city departments, which were not charged for their use of water. Mayor Fitzgerald, in his order just issed, quotes the figures of Metcalf and Eddy as to the waste, and the resulting deficit to the water department, and requires each department hereafter to pay for the water it uses. Metcalf and Eddy estimated that actual waste of water reached an annual total of $25,000; while the loss of revenue to the Water Department was set at over $300,000. Mayor Fitzgerald quotes the engineers' figures and adopts their recommendation. The value of expert investigation of city affairs could hardly be better demonstrated.

TYPES OF HIGHWAY BRIDGES*

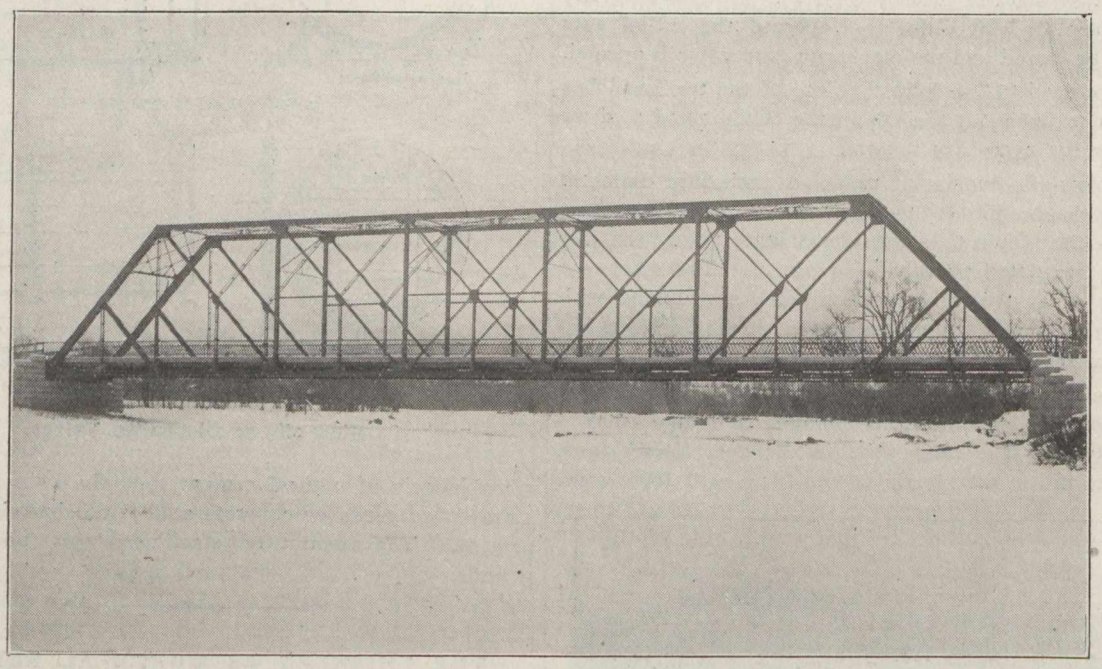
BALTIMORE TRUSS BRIDGE OVER THE HUMBER RIVER ON SCARLETT ROAD, YORK COUNTY.

THE SCARLETT BRIDGE spans the Humber River about a mile south of Weston. The stream is 200 feet wide at this point, and the bottom shale rock. The traffic carried is heavy.

In the layout of the bridge one question to be decided was the relative merits of a single-span bridge or one of two spans, with a centre pier. Estimates for each plan follow:—

	(1) Single Span.	(2) Double Span.
Steel superstructure with concrete floor	$10,700 00	$8,300 00
(1) Abutments; (2) Abutments and pier	4,450 00	6,750 00
Filling approaches	300 00	300 00
Temporary bridge and removal of old bridge	250 00	250 00
	$15,700 00	$15,600 00

The cost being nearly the same for either method, the single span was adopted for the following reasons: first, because of the undermining effect of freshets on piers and the abrasion of ice, centre piers should be avoided when possible; secondly, the waterway is



better without a centre pier, even when the distance between abutments is decreased according to the width of the pier; thirdly, the much heavier steel structure required for a single span would be more permanent than lighter structures on account of the greater thickness of metal.

Span, 203 ft., centre to centre of bearings.
Roadway, 16 ft. clear.
Height of trusses, 29 ft.
Contractors for substructure and floor, O. L. Hicks & Son, Humber Bay, Ont.
Contractors for steel superstructure, Ontario Bridge Co., Toronto, Ont.
Reinforcement for floor, "No. 10, heavy" expanded metal, manufactured by the Expanded Metal and Fireproofing Co., Toronto.
Mill and shop inspection, Canadian Inspection Co., Montreal and Toronto.
This bridge is one of the longest single-span highway bridges with a concrete floor in Canada.

REINFORCED CONCRETE BRIDGES.

CONCRETE IS NOT a new or experimental building material, but is one of the oldest of which we have record, and the recent device of reinforcing concrete with steel has added greatly to its safety and economy. A well-designed and well-constructed concrete arch is one of the safest, most durable and most beautiful forms of bridge, and where the situation is favorable it is often cheaper than a steel bridge with a concrete floor.

*This information has been compiled by Barber & Young, Bridge and Structural Engineers, of Toronto. The bridges described were designed and supervised by them and completed in 1909.

However, the durability, and even the safety of a concrete arch depends entirely upon the design, the selection and proportioning of materials, and the care taken in construction. On the one hand, because of excellent design and workmanship, we have concrete arches built by the ancient Romans which remain to the present day, and numberless concrete arches built in the last fifteen years which have stood the severest tests without showing crack or flaw, and have grown harder and better with age. On the other hand, many concrete arches built in recent years, even with the advantage of steel reinforcement, have already partially or wholly failed on account of poor design or ignorance or carelessness in workmanship.

Amongst the common sources of danger may be mentioned, first, attempting to measure cement loose in wide barrows; secondly, using pit-run gravel without such additional aggregate as may be required, or without even testing its fitness, though it may contain an excess of sand, which is the usual case, or not enough sand, which sometimes happens. Again, some are deceived by the apparent simplicity of the outlines of an arch into supposing that the designing is so simple that it may be undertaken by one who has given the matter no special study, and who would not attempt to design a steel bridge. Nothing could be farther from the truth. Reuterdahl says in his work on arches: "Of all the problems of bridge engineering, the analysis of the arch is by far the most difficult."

All our arches are designed and analysed in accordance with the theory of elasticity.

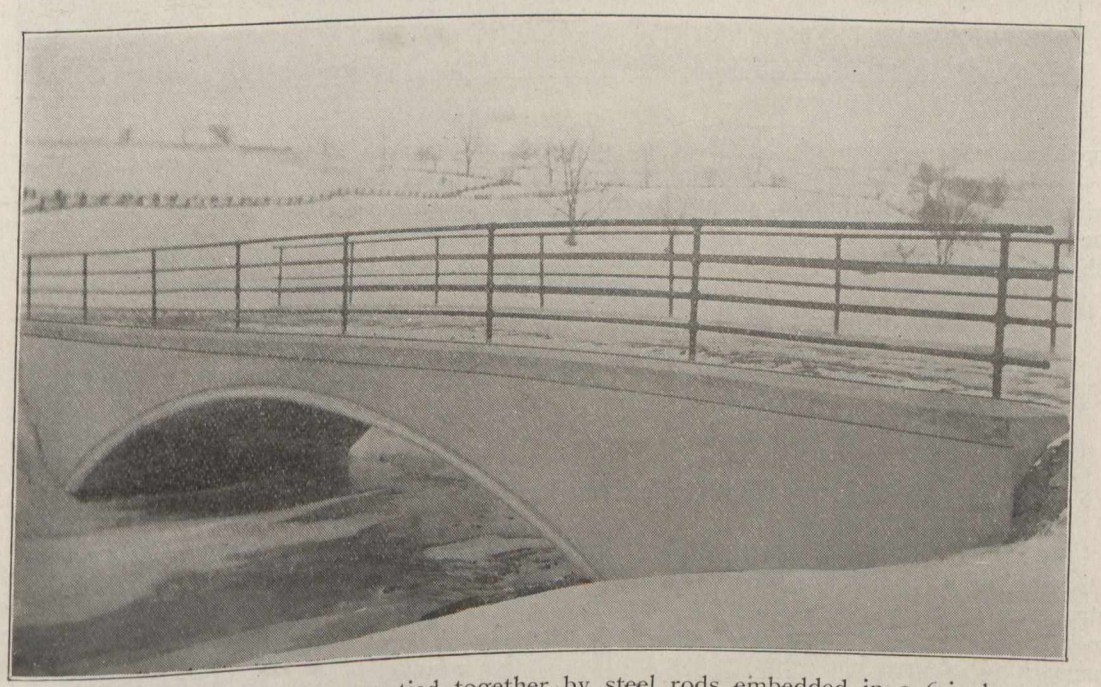
Where there is not sufficient height for an arch from water to roadway, or where the foundations would require too expensive treatment to enable them to resist the great horizontal thrust of an arch which tends to spread the abutments apart, or where it is desired to build a new superstructure upon old abutments and piers, a reinforced concrete girder or truss bridge may be constructed for about the same price generally as a good steel bridge.

Examples of the several types mentioned above, with some remarks as to the special features of each, are given in the succeeding pages.

BRIDGE ON TOWNLINE BETWEEN KING AND VAUGHAN TOWNSHIPS, COUNTY OF YORK.

A FLAT ARCH should not be constructed in a situation where piling is required without exceptional care in designing the foundations, for if the abutments spread even slightly the arch will crack—sometimes to a dangerous extent.

The bridge illustrated is an example of one method of treating a quicksand bed. Here several rows of piles, 20 feet long, driven to refusal, formed the foundation on each

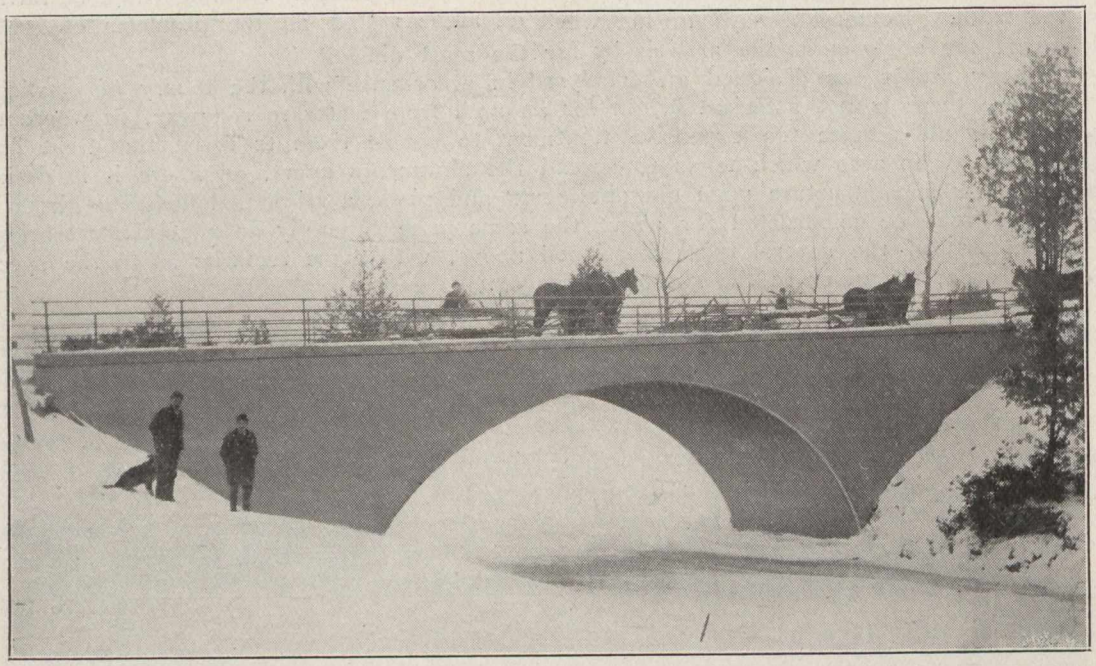


side. The concrete abutments were tied together by steel rods embedded in a 6-inch concrete slab, three feet below the surface of low water, which may be described as an invert or apron, forming the bed of the stream.

Clear span, 45 ft.
Roadway, 14 ft.
Rise of arch, 5 ft. 6 in.
Distance from roadway to low water, 8 ft. 6 in.
Contractor, John A. Watson, Laskay, Ont.
Cost, complete, $2,862.

ARCH AT KLEINBERG, ONT.

THIS IS AN example of a rather high arch on a grade of 6 per cent., which necessitated an average of two feet greater depth of filling, or about 240 pounds per square foot greater weight, on one side of the arch than on the other. If the design had not been specially prepared to meet this condition this would have imposed a much greater additional strain upon the arch than the heaviest live load that it would ever have to bear. There are two methods by which such unsymmetrical loading may be provided for. One is to distort the curvature of the arch in accordance with computation so that it may properly resist the unequal loads, and the other is to correctly balance the loads on either side of the arch by using lighter filling material on one side than on the other. In the Kleinberg arch recourse was had to both methods. The curvature was only slightly changed from the symmetrical so as not to be very noticeable to the eye, and in addition to this cinders were used for a



considerable proportion of the filling on one side of the arch and boulders on the other.

It may be mentioned that in general the height of roadway from river bed affects the price of an arch (or, indeed, of any kind of bridge) much more than the span. As an example, the Kleinberg arch contains nearly double the quantity of concrete of the Vaughan arch (shown on the preceding page), although the span is only five feet greater.

Clear span of arch, 50 ft.
Roadway, 16 ft.
Height of floor from low water at crown of arch, 17 feet.
Rise of arch, 13 ft. 6 in.
Cost of arch and filling, $3,535.

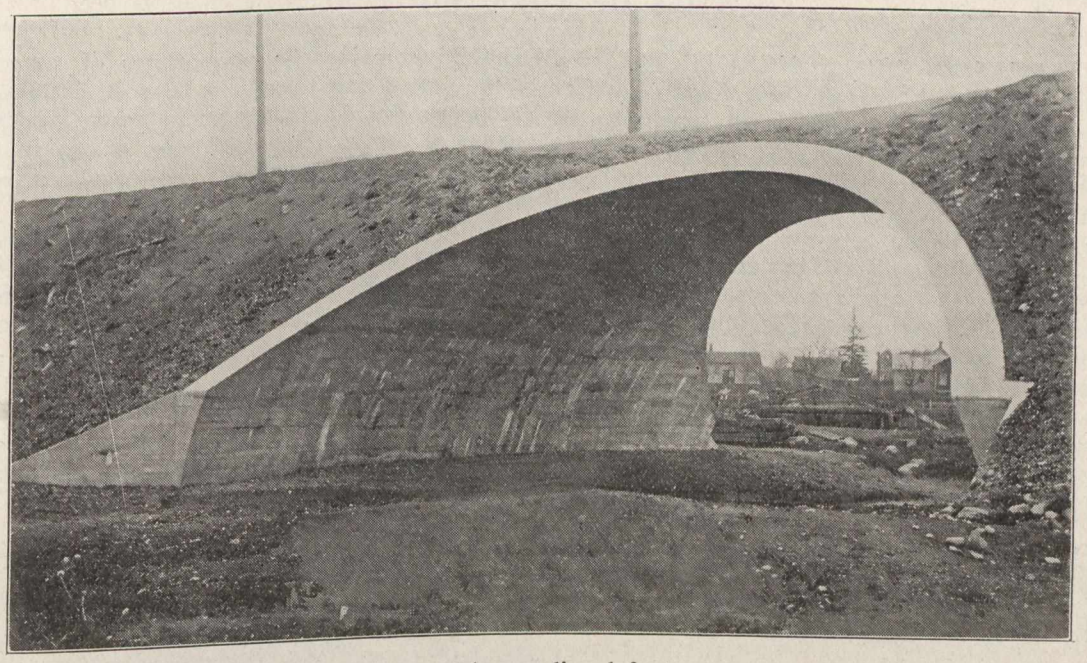
ARCH OVER HOLLAND RIVER, NEWMARKET, ONT.

THIS ARCH IS not a highway bridge, but was designed by us for the Metropolitan Division of the Toronto and York Radial Railway, and is introduced here as a type of structure which might well be used for highway bridges approached by very high embankments. Here the depth of fill would have necessitated very expensive wing walls if the more usual kind of arch had been adopted. This design resulted in a saving of about 18 per cent. over an arch with wing walls, and brought the first cost somewhat below that for a steel bridge with concrete abutments and wing walls.

To adapt this bridge to highway traffic it would only be necessary to place a fence on either side at the top of the fill.

Clear span of arch, 50 ft.
Rise of arch, 23 ft.
Height of roadway from water, 27 ft.
Width of abutments at the springing line, 94 ft.

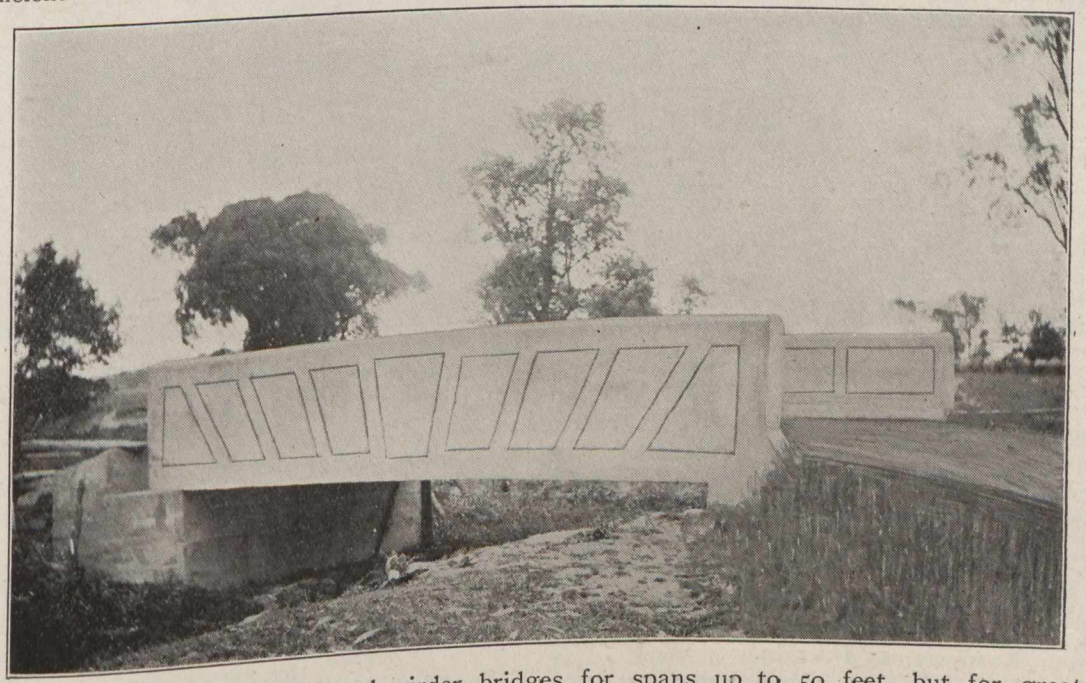
Width across arch at crown, 21 ft.
Earth fill over crown, 2 ft. 6 in.
Thickness of arch at crown, 1 ft. 6 in.



Designed for a load of 5,000 pounds per lineal foot.
Contractors, O. L. Hicks & Son, Humber Bay, Ont.

THE HOLLY BRIDGE, CONCESSION 5, YORK TOWNSHIP.

CONCRETE GIRDER BRIDGES are suitable for short spans in situations where the distance from floor to low water will not permit of an arch. Even where this distance is sufficient for a low arch the girder bridge is generally more economical if the foundations require piling. We have designed girder bridges for spans up to 50 feet, but for greater spans than this the concrete truss bridge described on the following page is preferable.



Span, 30 ft. clear.
Distance from floor to low water, 8 ft.
Roadway, 16 ft.
Weight of superstructure, 60 tons.

Contractors, McLennan & Alexander.
Cost of abutments and superstructure, $1,299.

MIDDLE ROAD BRIDGE OVER THE ETOBICOKE RIVER, BETWEEN THE COUNTIES OF YORK AND PEEL.

REINFORCED CONCRETE TRUSS BRIDGES combine the permanence of concrete construction with the graceful lines of trusses with curved top chords at a cost practically the same as that of good steel structures with concrete floors. In situations where yielding foundations or insufficient rise render the employment of an arch impracticable, or, as in the present case, where a new superstructure is required on the old abutments, an equally artistic result may be secured at no greater cost and with no attendant structural uncertainty by the use of a reinforced concrete truss span.

The Middle Road bridge, the first structure of its kind to be built in Canada and one of the first in America, was officially opened in October, 1909. During construction and since completion it has excited a great deal of interest among engineers and municipal officers from its novel character and the possibilities suggested by its successful completion and operation. The severest load for a highway bridge, consisting of a densely packed herd of rearing, trampling cattle, which weighed not less than 35 tons, was applied on opening day, and failed to produce more than a tremor. The contention was thus justified that in a massive concrete structure the impact effect of teams trotting down the grade of 5 per cent., which was necessitated at this point, would be very small.

The commissioners for whom the bridge was built were Warden Geo. S. Henry, W. D. Annis and J. E. Harris, of York, and Warden Jackson and T. L. Kennedy, of Peel. The contractors were O. L. Hicks & Son, of Humber Bay, Ont.

The steel reinforcement used was principally plain round rods for the trusses, beams and hand-rail, and for the floor slab it was expanded metal, manufactured by the Expanded Metal and Fireproofing Co., of Toronto.

We shall be pleased to send on application to municipal officers or others who may be interested a booklet describing this bridge more fully.

Span, 82 ft., centre to centre of bearings.
Roadway, 15 ft. 2 in.
Height of floor above water, 14 ft. at one end and 18 ft. at the other.
Weight of superstructure, 200 tons.
Cost of superstructure, $3,190.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	RAILWAY EARNINGS. Date from	Date to	1910	1909	STOCK QUOTATIONS TORONTO Price Feb. 18 '09	Price Feb. 10 '10	Price Feb. 17 '10	Sales Week End'd Feb. 17
Canadian Pacific Railway...	10,048	$150,000	$100	Jan. 1	Feb. 14	$8,895.000	$7,103.000	172½	179⅞	179½	208
Canadian Northern Rail'y.	3,180	.....	.....	"	Feb. 21	1,245 600	897.200	.....	.....	.....	.....
*Grand Trunk Railway	3,536	226,000	100	"	Feb. 14	4.982.550	3,879,636	*1st. pref. 103½, 3rd pref. 50½, ord'y 20⅜.			
T. & N. O.....	264.74	(Gov. Road)	.....	"	Feb. 14	187.355	110,975	.....	.....	.....	.....
†Montreal Street Railway...	141.79	18,000	100	"	Feb. 19	524.425	502,340	209 208½	222 221	222½ 221	685
Toronto Street Railway,...	114	8,000	100	"	Jan. 2.	298,612	263,513	119⅞	125 124	125 124	45
†Halifax Electric.....	13.3	1,400	100	"	Feb. 14	22,370	20,371	108½ 108	124 120	124 120	.....

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

CALGARY STREET RAILWAY

The January returns of the Calgary Street Railway show a cost of 7.23 cents per car mile for propelling, heating and lighting.

OPERATING EXPENSES		Cents per Car mile.
Maintenance of Ways and Structures		
Track and roadway	$ 321.90	
Electric lines	81.00	
Building and fixtures	11.25	
Total	$ 414.15	.829
Maintenance of Equipment		
Cars	$ 349.21	
Electric equipment of cars	298.43	
Shop expenses	68.45	
Total	$ 716.09	1.434
Transportation		
Power for operation	$3,617.50	7.425
Superintendence of transportation	39.00	
Wages of conductors and motormen	3,069.10	6.147
Car service supplies	19.35	
Miscellaneous car service expenses	211.14	
Cleaning and sanding track	33.01	
Total	$6,969.10	13.998
General Expenses		
Salaries of general officers	$ 380.00	
Salaries of clerks	50.00	
Printing of stationery	109.30	
Miscellaneous office expenses	22.63	
Miscellaneous gen'l expenses	45.75	
Rent of land and buildings	35.00	1.287
Total	$ 624.68	
Gross operating expenses	$8,762.02	17.550
Balance revenue over same	2,802.58	

N.B.—This statement does not include insurance, interest, or other fixed charges.

Cost of power—7.23 cents per car mile, or $3,617.50.

Average earnings of one car in one day on each route:—

Red line	$34.13
Blue line	36.93
White line	24.47

General average, $33.39.

Average number of passengers carried per day, 8,927.

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

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

9428—January 31—Authorizing the town of Macleod, Alta., to lay water main under tracks of the C.P.R. at 3rd Ave.

9429 to 9433 Inc.—February 1—Authorizing the Manitoba Government Telephones to carry wires over the tracks of the G.T.P., and C.N. Railways at five different points in that province.

9434 and 9435—February 1—Authorizing the Citizens Telephone Company to carry wires across the tracks of the C.P.R. at 3rd highway crossing east of Adamsville, and at the highway crossing south of Knowlton, Que.

WEEKLY EARNINGS

NAME OF COMPANY	TRAFFIC RETURNS Week Ending	1910	Previous Week	1909
Canadian Pacific Railway.	Feb. 14	$1,450,000	$1,450.000	$1,157 000
Canadian Northern Rail'y..	Feb. 21	165,500	189,300	129,50
Grand Trunk Railway	Feb. 14	719.889	729.257	631,69
T. & N. O.....	"	28,048	27,953	20,04
Montreal Street Railway...	Feb 19	75,270	72,589	74,132
Toronto Street Railway....	"	76,141	74,035	65,844
Halifax Electric.....	Feb. 14	3,437	3,475	3,124
†London Street Railway....	"	18,063	.....	17,454

†For month of January—31 days.

9436 and 9437—February 1—Authorizing the Horton & McNab Telephone Company to carry wires across the tracks of the Canada Atlantic Railway at a point on Lot 1, Con. 5, Tp. of Horton, at Goschen Station, and the C.P.R. at a point on Lot No. 5, Con. 6, Tp. of Horton, 3½ miles east of the Central Station, Renfrew, Ont.

9438—February 1—Authorizing Bell Telephone Company to carry wires across tracks of the Chatham, Wallaceburg & Lake Erie Railway Company at St. Clair St., 1¼ miles north of railway power house, Chatham, Ont.

9439—February 1—Authorizing the Parkhill Rural Telephone Company to carry wires across G.T.R. at public crossing 4¾ miles west of Parkhill Station, Con. 21, Tp. of West William, Ont.

9440—January 31—Approving location of C.P.R. station at Wattsburg, B.C.

9441—February 1—Authorizing the C.P.R. as lessees of the Vancouver & Lulu Island Railway to construct its railway over portions sub-divisions 3 and 44 of Lot 22 Block 36, and across Queen Ave., from a point on the British Columbia Electric Company's tracks to a point on a certain siding of the C.P.R., and also along and across 14th Street from a point on a certain siding of the C.P.R. to a point on the V. & L. I. Railway in New Westminster, B.C.

9442—February 1—Authorizing the Temiscouata Railway to construct bridge over the Cabano River, Que.

9443—January 27—Directing the G.T.R. to cross the highway at Lot 5, Concession Road between 3rd and 4th Concessions of the Township of Louth at right angles, install and maintain an electric bell, one fifth of the cost of bell to be paid out of the Railway Crossing Grade Fund.

9444—January 27—Authorizing the C.N.O. Railway to construct its railway across public road between Lots 2 and 3, Con. "B," Tp. of Hamilton.

9445 and 9446—February 1—Approving plans of Bridge No. 5, at mileage 10, over the Rocky River Temiscouata Railway, also No. 29 at mileage 75 over the Silver Stream on same railway.

9447—January 31—Dismissing application for apportionment of costs of providing and constructing suitable highway crossing over Red Mountain Ray at a point south of Pattersons Creek, B.C., as provided for in Order No. 7787.

9448—February 1—Approving revision of location of C.N.O. Railway on Livingstone Farm in Township of Hamilton, Ont., mile. 169 from Ottawa.

9449—January 27—Authorizing E. N. Richards, of Windsor, Ont., to carry light and power wire over the tracks of the G.T.R. at Farm Lot 102, Tp. Sandwich East, Essex Co., Ont.

9450—February 1—Rescinding Order No. 9372, dated January 21st, 1910, dis-application of the Hazeldean Rural Telephone Company for Order directing the Bell Telephone Company to provide and furnish a better connection with the Rural Telephone Company's system at a point near Ottawa.

9451—February 1—Authorizing the C.P.R. to construct, maintain, and operate a spur to the Bird's Hill Sand Company's Pit, authorized by Order No. 3796; and also to construct four sidings from the said extension.

9452—February 1—Authorizing the G.T.R. to reconstruct bridge carrying its railway across Erie Street, in Stratford.

9453—January 28—Authorizing the G.T.R. to construct, maintain, and operate a branch line or siding in the town of Hanover, extending from a siding into the premises of William Knechtel & Son.

9454—January 27—Authorizing Everiste Nomore Richards, of Windsor, to lay and thereafter maintain a water main under the track of the G.T.R. where the same intersects Farm Lot 102 in the 1st Concession of the Township of Sandwich East, County of Essex, Ontario.

9455—February 1—Approving of the rules and regulations of the Boston and Maine, and the Maine Central Railroad Companies, in so far as they govern the operations of the trains of the said companies in Canada.

(Continued on page 189).

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.

Fuller information may be found in the issues of the Canadian Engineer referred to.

Place and Work.	Tenders close.	Issue of.	Page.
Winnipeg, Man., fence, gates	Feb. 28.	Jan. 21.	65
London, Ont., electrical apparatus	Feb. 25.	Jan. 28.	91
Ottawa, Ont., wooden tank	Mar. 1.	Feb. 4.	40
Ottawa, Ont., piers	Feb. 28.	Feb. 4.	111
Toronto, Ont., cast iron pipe	Feb. 22.	Feb. 4.	40
Calgary, Alta., pipe, valves	Feb. 25.	Feb. 11.	46
Toronto, Ont., steel and stone	Mar. 1.	Feb. 11.	46
South March, Ont., dredging	Mar. 1.	Feb. 11.	136
Winnipeg, Man., bridge	Mar. 7.	Feb. 11.	136
Winnipeg, Man., asphalt	Feb. 25.	Feb. 11.	136
Edmonton, Alta., bridge	Mar. 12.	Feb. 11.	136
Moncton, N.B., railway	Mar. 15.	Feb. 18.	160
Ottawa, Ont., pine timber	Mar. 16.	Feb. 18.	160
Orillia, Ont., pumping machinery	Mar. 7.	Feb. 18.	160
Winnipeg, Man., asphalt plant	Mar. 1.	Feb. 18.	160
Edmonton, Alta., telephone mater'l	Mar. 1.	Feb. 18.	161
Nanaimo, B.C., sewer pipe	Mar. 1.	Feb. 18.	161

TENDERS.

Sydney, N.S.—Tenders will be received until 5 p.m. Wednesday, 2nd March, for the erection of a Fire Station. D. McD. Campbell, City Engineer.

Moncton, N.B.—Tenders will be received up to and including Tuesday, March 15th, for the construction of a line of railway between Nelson and Chatham, N.B., a distance of 8.28 miles. Plans and specifications may be seen at the Station Master's Office, Chatham, N.B., and at the Chief Engineer's Office, Moncton, N.B., where forms of tender may be obtained. A. W. Campbell, Chairman, Government Railways Managing Board, Ottawa, Ont.

Montreal, Que.—Tenders will be received up to 1st March at 4 p.m., for the electric lighting of the Town of Maisonneuve by arc lamps, style "magnetite" (last model), of 1200 to 1500 candle power. The contract to be for one hundred lamps, with privilege for the Town to increase that number. M. G. Ecrement, Secretary-treasurer, Town of Maisonneuve.

Montreal, Que.—Tenders are desired until 7th March for supply of coal and wood required to heat military buildings at Montreal and Three Rivers for year ending March 31st, 1911. Particulars may be obtained from Officer Commanding Quebec Division at Montreal.

Brockville, Ont. — Tenders are invited for taking out 1,000 cords of stone for street purposes. Dr. Gowan, chairman Board of Works.

Brockville, Ont.—Tenders will be received up to Thursday, 3rd March, for the excavation of rock on Abbott Street to be used for street purposes. Geo. K. Dewey, Town Clerk.

Toronto, Ont.—Tenders will be received until Tuesday March 8th, for sewer construction on the following streets Hugo, Follis, Mavety, Boultbee, Beresford, Seymour, Baxter. C. H. Rust, city engineer.

Sault Ste. Marie, Ont.—Tenders will be received until April 15th, for clearing grading and bridge work on a 31-mile section of the Algoma Central and Hudson Bay Railway between Hawk Lake Junction, Algoma Central and Hudson Bay Railway, and Hobon, C.P.R. C. N. Coburn, Chief Engineer. (Advertisement in the Canadian Engineer).

Toronto, Ont.—Tenders for Grading.—Tenders will be received up till 12 o'clock noon, on Monday, February 28th, for labor, tools, machinery, and other plant, services and material necessary for the grubbing, grading, embankment protection, clearing and culverts in the construction of a cut-off on the Main Line of the Temiskaming and Northern Ontario Railway, between M.P. 60 and M.P. 61. Plans and specifications may be seen at the office of the Commission, 25 Toronto Street, Toronto, and at the office of the Chief Engineer, North Bay. A. J. McGee, Secretary-treasurer, Toronto.

Toronto, Ont.—Tenders for the supply of Coal and Fuel Wood required to heat the Military Buildings at Toronto, Hamilton, Brantford, St. Catharines, Dundas and Burford, Ont., for the year ending March 31st, 1911, will be received up to Monday, March 7th next. The Officer Commanding Western Ontario, Toronto, will furnish full particulars.

Kingston, Ont.—Tenders for the supply of Coal and Fuel Wood required to heat the Military Buildings at Kingston, Belleville, Port Hope, Cobourg, and Peterborough, Ont., for the year ending March 31st, 1911, will be received up to Monday, March 7th next. Full particulars may be obtained from the Secretary of the Militia Council, Ottawa, or at the office of the District Officer Commanding Kingston.

Kingston, Ont.—Tenders for the construction of Masonry or Concrete Foundations for Two Houses on William Street, will be received up to Saturday, February 26th. H. B. R. Craig, City Engineer.

Lindsay, Ont.—Tenders will be received by the undersigned until March 10, 1910, for the whole or separate trades required in the erection of a Nurses' Residence for the Ross Memorial Hospital, Lindsay. Plans may be seen at the office of the Flavelle Milling Company, Lindsay. J. D. Flavelle.

Ottawa, Ont.—Tenders will be received until 5 p.m., Friday, February 25th, for the supply of oil and grease for the Departmental plant. Napoleon Tessier, Secretary, Department of Public Works.

Ottawa, Ont.—The City of Ottawa. Municipal Electric Department calls for tenders on meters, transformers, incandescent and arc lamps, wire, globes, carbons, hardware and sundry supplies. Tenders will be received at the office of the Electric Department, 21 Sparks Street, Ottawa, until noon, 1st March. J. E. Brown, Superintendent.

Port Arthur, Ont.—Tenders are requested for the erection of a Masonic Temple in Port Arthur, foundation already built. M. B. Aylesworth, Architect, 27 Cumberland Street.

St. Thomas, Ont.—Tenders will be received until noon, Saturday, March 5, for the construction of reinforced concrete abutments for a 133-foot span of a roadway bridge over the Otter Creek at Port Burwell; also for a 60-foot arch bridge over Kettle Creek, Lynhurst. James A. Bell, County Engineer, St. Thomas. (Advertisement in The Canadian Engineer).

Waterford, Ont.—Tenders will be received by the undersigned until 6 o'clock p.m., March 7, 1910, for lighting the streets of the Village of Waterford, with fifty 32-candle power incandescent lights. James Ross, Clerk.

Regina, Sask.—Tenders will be received until Thursday March 10, for insulators, top pins, cross arms, guy wires and pole line hardware. S. P. Porter, Deputy Minister, Department Railways and Telephones.

Saskatoon, Sask.—Tenders will be received until March 14th and March 21st for the following material required in connection with waterworks and sewage disposal:—

Contract "B"—Cast Iron Pipe and Specials.
" "C"—Hydrants, gate valves and valve boxes.
" "D"—Sewer pipe and junctions.
" "E"—Steel Stand Pipe.

Plans, etc., may be seen at the "Canadian Engineer" offices, 62 Church Street, Toronto; B33 Board of Trade Building, Montreal; 315 Nanton Building, Winnipeg. George T. Clark, City Engineer. (Advertisement in the Canadian Engineer.)

Moose Jaw, Sask.—Tenders will shortly be invited for street paving estimated to cost $140,000. Angus Smith, city engineer.

Vancouver, B.C.—Tenders will be received for driving approximately 600 piles for foundation of mill and platform. J. Hanbury, 1756 Robson Street.

Victoria, B.C.—Tenders will be received up to 7th March, 1910, for 150,000 imperial gallons Creosote. Wm. W. Northcott, Purchasing Agent.

CONTRACTS AWARDED.

Hamilton, Ont.—Some recent contracts awarded to the Smart-Turner Machine Company, of Hamilton, include:—Corporation of Port Colborne, Ont., a motor-driven triplex power pump for the waterworks pumping station; Hudson's Bay Company, Edmonton, Alta., a simple outside packed plunger pump for their steamer; Kingston Shipbuilding Company, Kingston, Ontario, an independent jet condenser; Fowlers — Canadian Company, Hamilton, a duplex tank pump. Other recent contracts are for all kinds of pumping equipment.

Fort William, Ont.—The Jones Electrical Company has secured the contract to build four miles of transmission line from the line of the Kam. Power Company to the sub-station in Port Arthur for the Hydro-Electric Commission.

London, Ont.—Tenders have been received as follows for 2,000 feet of hose for the fire department: Cleveland Hose Co., Cleveland, Ohio, 97 cents per foot; Gutta Percha and Rubber Co., Toronto, $1.05 per foot; Dunlop Rubber Co., Toronto, $1.6 per foot; Canadian Rubber Co., Montreal, $1.10 per foot. The acceptance of the Cleveland company's tender was recommended, but the contract was not awarded. Six hundred feet of "Maltese Cross" chemical hose at 40 cents will be purchased from the Gutta Percha and Rubber Company, of Toronto.

Ottawa, Ont.—The International Marine Signal Company, the lowest tenderers for three thousand feet of pipe for the river section of the new waterworks intake, will probably receive the contract. There were fourteen tenders in all, including some from Great Britain, the United States and various Canadian cities, and the prices ranged from $17,290 to $31,657. The pipe for the aqueduct section will be of reinforced concrete.

Ottawa, Ont.—The Ottawa Steel Casting Company made a mistake in their tender for the dredging bucket, and the contract was awarded later to Thos. Lawson & Sons.

Toronto, Ont.—F. H. Dickenson of Hamilton was awarded the contract for constructing the outfall sewer in connection with the new sewage disposal works, at $125,504. The Construction & Paving Company of Toronto tendered at $104,900, but withdrew their bid before it was opened. The Canada Foundry Company of Toronto was awarded the contract for special castings, but the pipes, valves, cranes etc., will be supplied by English firms.

Here are the tenders:—

BUILDING SEWAGE TANKS:—Construction & Paving Company, Toronto, $104,900. *F. H. Dickenson, Hamilton, $125,504. Others were $159,000 and $184,700.

LAYING OUTFALL SEWER:—*Miller, Cummings & Robertson, $59,750; only other tender $69,000.

TILE WEIR CRESTS:—Doulton & Company, a British firm; 2-inch, 30 cents; 3-inch, 38c.; 4-inch, 45c.; 6-inch, 55c.; 12-inch, 77c.

IRON CASTINGS:—Awarded to Joseph Williamson & Company.

Covers and Frames per ton.	Valve Stem, Box and covers, each.
$49.86	.79c.
79.00	
*42.00	.60
63.90	.93
75.50	.65
70.00	.85
75.00	
52.60	

The Canada Foundry received contracts for steel I. beams at $45 a ton and cast iron columns at $55 a ton, while the Advance Machine Works Company were given the order for cranes at $825. Other bids for cranes were:—$512, $876, $925, $1,125, and $1,440.

Tenders for sludge valves, complete, each, were:—$43.40; $17; $19.20; $42.75; $37.25, and for 18-inch circular penstocks, each, $62.40, $32, $36, $55, $45.65.

CAST IRON PIPE.—Awarded to D. Y. Stewart & Co., 10-inch cast-iron pipe, $31.50 per ton; 8-inch cast-iron pipe, $31.50 per ton; special castings, bends, etc., 18-inch in diameter, $59.70 per ton; special castings, bends, etc., $59.70 per ton.

Canada Foundry Company, special castings, bends, etc., $58.97 per ton.

*Accepted.

Winnipeg, Man.—Contract for a Russell automobile for the Street Commissioner awarded to the Canada Cycle and Motor Company, at $1,700.

Winnipeg, Man.—The Algoma Bridge Company will probably receive the contract for the erection of the new Louise bridge. Contract price in neighborhood of $126,000.

Vancouver, B.C.—The following tenders were received for paving, the contract for which has not yet been awarded:

Name of Contractor.	Georgia from Burrard to Cardero.	Georgia from Cardero to Chilco.	Burrard from Hastings to Nelson.	Howe from Robson to Nelson.	Beatty from Pender to Georgia.
*M. P. Cotton	$59,392	$39,400	$55,950	$8,232	$22,427
*Palmer Bros. & Henning	55,791	37,729	53,917	7,685	20,620
†Hassam Paving Co.	57,484	36,443	55,108	7,893	21,625
‡M. P. Cotton	52,413	36,913	48,494	7,153	19,326
§Palmer Bros. & Henning	64,189	42,083	60,773	8,954	23,547
§R. S. Blome Company	68,663	47,433	66,470	9,638	24,859
‖Palmer Bros. & Henning	59,076	41,588	56,655	8,308	21,748
‖Warren Const. Company	71,310	52,733	69,450	10,108	25,662
‖Warren Const. Company	59,793	46,345	57,424	8,357	21,212
	55,258	44,024	52,949	7,704	19,577

*Wood block.
†Hassam.
‡Concrete.
§Granitoid.
‖Bitulithic.

Calgary, Alta.—The Calgary Water Power Company have just placed an order with the Robb Engineering Company, of Amherst, N.S., for a 1,000 horse-power vertical Cross compound condensing engine complete with condenser, heater and pump. They have also placed an order with the Canadian Westinghouse Company, of Hamilton, Ont., for a 600 K.W., alternating current generator, complete with exciter and switchboard.

Burlington, Vt.—The Burlington Light and Power Company has purchased a 1,000 kilowatt Westinghouse high-pressure turbine generator set for local lighting and power service. The turbine utilizes steam at 150 pounds, exhausting into a vacuum of 28 inches. Three-phase, 60-cycle power is generated at 2,300 volts, at which pressure it is served to the local distribution lines, and reduced by pole-top transformers for lighting and power in the city of Burlington.

RAILWAYS.

St. Johns, Nfld.—The Government of Newfoundland has introduced in the Legislature resolutions providing for the construction of a number of branches to the Reid-Newfoundland Company's road as follows: 1. From Shoal Harbor, via Trinity, to Bonavista. 2. From Broad Cove, via Hearts' Content, to Grates Cove. 3. From St. Johns, via Southern Shore, to Trepassey. 4. From Come-by-Chance to head of Fortune Bay. 5. From Howley to Bonne Bay. The total length is about 250 miles and the estimated cost, $15,000 a mile, in cash, or about $4,000,000 altogether. Not less than fifty miles of road is to be completed annually. All the rolling stock is to be constructed in the colony.

Sydney, N.S.—The Dominion Railway and Plaster Company will probably be permitted to build and operate a street railway here.

Montreal, Que.—The Montreal Underground and Elevated Railway, capital $20,000,000, seeks a charter and power to build and operate underground and elevated railways in Montreal. Lieut.-Col. T. B. Butler is attorney for the applicants.

Guelph, Ont.—Engineer Warfield has completed a preliminary survey of the proposed Peoples' Railway between

Guelph and Hespeler, with a branch to Puslinch Lake. The first few miles follow the main line from here to Berlin. Leaving the main line, there will be a branch to the south, which for the next three miles will keep to the river's level to escape heavy grades, and then the route will be direct into Hespeler.

Winnipeg, Man.—Contracts for supplies for the Alberta and Great Waterways Railway totalling upwards of $3,000,000 have been awarded by President W. R. Clarke, including 40,000 tons of 56-pound steel rails, to the Algoma Steel Company, bolts from the Toronto Bolt Company, spikes from the Peck Rolling Mills, Montreal, and fishplates and angle bars from the Nova Scotia Steel and Coal Company. The steel will be sufficient to cover the entire line to Fort McMurray.

Moose Jaw, Sask.—The city council is considering an application from Eastern capitalists, who want a 20-year street railway franchise.

Edmonton, Alta.—The connecting link in the final survey of the C.N. route from Edmonton to Vancouver by way of North Thompson River and Kamloops has been completed between Yellowhead Pass and a point on the North Thompson where the surveys were completed to last year.

Vancouver, B.C.—Two interurban and interdistrict railway propositions are being considered for the lower mainland of British Columbia. Before the House at Ottawa is the petition of the Burrard Inlet Tunnel and Bridge Company, the incorporators of which are acting for the municipalities of North Vancouver, Vancouver city, district of South Vancouver (which is seeking incorporation as a city), district of Burnaby and district of Point Grey. The object is to construct a tunnel under the First Narrows, the entrance to Burrard Inlet, with a line through North Vancouver, thence across the proposed bridge at Second Narrows, thence south-westerly to Eburne, six miles south of Vancouver, on the Fraser River.

The Vancouver, New Westminster, Terminal and Dock Company's proposal is now before the authorities at Victoria. They want to operate an electric line between Vancouver and New Westminster, running from Vancouver along the southern shore of English Bay, thence through Point Grey district to Eburne, and along the north bank of the Fraser to New Westminster. It is also proposed to construct extensive docks on English Bay. This application is being opposed by the C.P.R., the British Columbia Electric Railway Company and the city of Vancouver.

LIGHT, HEAT AND POWER.

Summerside, P.E.I.—A new contract relating to street lighting has been made between this town and the Sun Electric Company, who have agreed to install twenty 80-candle power and forty-six 32-candle power Tungsten lamps, with all modern equipment. The extensions are estimated to cost $1,500.

Saskatoon, Sask.—The council have appointed a special committee to arrange terms with the Saskatchewan Power Company.

FINANCING PUBLIC WORKS.

The following municipalities recently sold debentures:—
Moose Jaw, Sask., $45,000.
Yorkton, Sask., $40,000.
North Toronto, Ont., $5,000.
Quebec, Que.—$200,000, technical school.

Fredericton, N.B.—Application will be made at the next session of the Legislative Assembly for an act authorizing this city to issue debentures for pavements to cost $30,000. J. W. McCready, city clerk.

Renfrew, Ont.—Ratepayers will vote on a $77,000 by-law to erect a power plant.

Brockville, Ont.—On Monday, the 14th March, the freeholders of Brockville will be asked to vote for the third time on a by-law to raise $16,000 by debentures for the reconstruction of six bridges within the bounds of the corporation.

Thorold, Ont.—D. P. C. Munro, town clerk, offers for sale $3,573 sewer debentures.

Taber, Alta.—A by-law to raise $15,000 for testing for gas and water carried.

Sweetsburg, Que.—Ratepayers have passed a $9,000 by-law to install waterworks.

Neepawa, Man.—Until March 11th, J. W. Bradley, sec.-treas., offers for sale $4,148 local improvement debentures.

PERSONAL.

Mr. A. F. Well, B.A.Sc., and **Mr. J. V. Gray,** formerly of the Bishop Construction Company, are carrying on a general engineering and contracting business under the name "Wells & Gray, Ltd.," at 315 Confederation Life Building, Toronto, Ont.

Mr. W. A. Leech has been appointed architect of schools at Vancouver, B.C. Mr. Leech was a lecturer on architecture and engineering at the Norwich, England, and Johannesburg, South Africa, Technical Institutes. He is a member of the Architect's Society of London, and studied at King's College, London.

Mr. A. L. Balsden, late manager of the St. Thomas Street Railway, has accepted a position with the Detroit River Tunnel Company.

Mr. George Y. Chown has resigned his position as Registrar of Queen's University and secretary of the School of Mining to devote his time to managing the affairs of the Wormwith Piano Works, of which he is now sole owner. Mr. Chown will retain the position of treasurer of Queen's.

Mr. D. D. England has resigned his position as parks superintendent of Victoria, B.C.

Mr. J. R. Dixon of the Cleveland Bridge and Engineering Company, Darlington, England, was a visitor at the Canadian Engineer offices in Toronto this week.

London, Ont.—Estimates for paving the market are being considered as follows: Vitrified brick, $15,525; asphalt, with 5-inch concrete base, $17,500.

OBITUARY.

Mr. John Douglas, a well-known contractor died recently. He was a native of Ireland, coming to this country in the sixties. Mr. Douglas had contracts, among others, in connection with the Windsor Hotel, Macdonald College at Ste. Anne de Bellevue, and the steel sheds on the harbour at Montreal.

COMING MEETINGS.

Ontario Good Roads Association, annual meeting at Toronto, Wednesday-Friday, March 2-4. J. E. Farewell, secretary, Whitby, Ont.

Canadian Cement and Concrete Association.—Annual Convention and Exhibition at London, Ont., on March 29th, April 1st. R. E. W. Hagarty, secretary, Engineering Building, Toronto University, Toronto.

Canadian Mining Institute.—Twelfth annual meeting at Toronto. March 2, 3, 4. H. Mortimer Lamb, secretary, Windsor Hotel, Montreal, Que.

Dominion Land Surveyors Association.—Annual meeting at Ottawa, March 1st and 2nd. Secretary, T. Nash, Topographical Survey Department, Ottawa.

Ontario Land Surveyors Association.—Annual meeting at Toronto, March 8, 9 and 10th. Captain Killaly Gamble, secretary, Toronto.

SOCIETY NOTES.

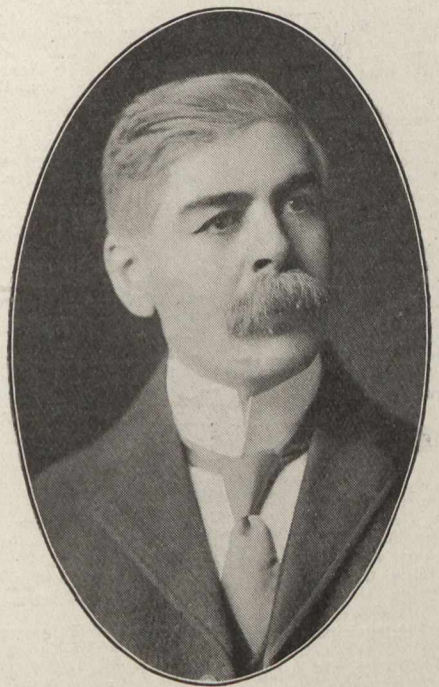
Alberta Association of Architects.—The annual meeting of the Alberta Association of Architects closed last Saturday forenoon. There was a representative attendance and much business of importance was discussed. The following officers elected: President, E. C. Hopkins, Edmonton; 1st vice-president, J. A. MacDonald, Lethbridge; 2nd vice-president, F. J. Lawson, Calgary; secretary, H. M. Whiddington, Strathcona; treasurer, C. L. Gibbs, Edmonton; council, R. Percy Barnes (Edmonton), James Henderson (Edmonton), H. D. Johnson (Edmonton), R. W. Lines (Edmonton), J. E. Wize (Edmonton), G. Fordyce (Calgary).

Engineers' Club of Toronto—Annual Dinner.—The ninth annual dinner of the Engineers' Club of Toronto, held on Thursday evening, February 17th, was probably the most enjoyable in the history of the Club. The toastmaster's chair was occupied by Mr. A. B. Barry, president for 1909, while Mr. C. M. Canniff, this year's president, acted as vice-chairman.

Toasts to "The King" and "Our Country" were proposed by Mr. Barry and responded to by Mr. Edmund Bristol, M.P., and Mr. J. G. Sing, Resident Engineer of the Department of Public Works of Canada.

Mr. Barry said the Engineers' Club was an institution to which they pointed with pride. They had passed through a good many vicissitudes, and the membership had grown from a very small beginning, ten years ago, to about three hundred at the present time. Much benefit had been derived from the social intercourse, while the lectures had been of inestimable value and all had striven to exalt the ethics of the profession.

In responding, Mr. Bristol, assured the members that it gave him great pleasure to be with them. He thought the engineers were the greatest people on earth—nearly. He said nearly because a distinguished architect was sitting next



C. M. Canniff
President of the Engineers' Club, 1910.

to him. There had been occasions when other people had been as high up in the world. He felt sure they were all proud to be Canadians, and it was on the members of the engineering profession that the future of Canada depended.

Mr. Sing agreed that the development of the country was undoubtedly due to the work of the engineers. It was an engineer who built the first steamboat to cross the Atlantic, and it was the engineers who would have to build the navy.

Dr. Galbraith, the honorary president, responded to "The Profession," proposed by Mr. Canniff. After listening to the patriotic addressess of Mr. Bristol and Mr. Sing he had been thinking the time would soon come when they would have to establish a department of naval architecture in the University of Toronto. Another department which would have to be considered was a department of aviation. Canada had conquered the land; it must now go into the sea and up in the air. They had among the graduates of Toronto University two men interested in aviation, and he would like to give them every encouragement.

"Sister Societies" was proposed by Mr. A. F. Macallum. city engineer of Hamilton, who said he was glad to extend a hearty welcome to gentlemen having much in common with the engineer. The engineer could not very well get along without the architect and the surveyor, and he wished them the success they deserved.

Mr. A. F. Wickson, president of the Ontario Association of Architects, Mr. H. W. Selby, vice-president of the Ontario Land Surveyors, Mr. R. G. Black of the Toronto branch American Institute of Electrical Engineers and Mr. J. C. Murton of the Engineering Society of Toronto University, made suitable replies.

Mr. C. M. Canniff, who is better known to some as "E. C. Easy, C.E.," gave a humorous, original recitation which all appreciated, while Messrs. R. A. L. Gray and J. R. Slack contributed to the programme of songs.

The success of the gathering reflects great credit upon Mr. W. Van R. Reynolds, chairman of the Reception Committee and Mr. R. B. Wolsey, the indefatigable secretary.

Among those present were:—A. F. Wickson, president of the Ontario Association of Architects; H. W. Selby, vice-president of the Ontario Land Surveyors; J. C. Murton, vice-president of the Engineering Society, Toronto University; Professor Angus, A. B. Barry, Frank Barber, R. G. Black, E. H. Beck, Dr. J. Boch, W. A. Bucke C. M. Canniff, C. M. Campbell, H. F. Codd, H. C. Champ, Willis Chipman, C. F. Deck, A. Duncan, A. D. Dame, John S. Fielding, Dr. John Galbraith, Capt. Killaly Gamble, R. A. L. Gray, Chester B. Hamilton, W. Almon Hare, T. W. Horn, T. Harry Mace, J. McGill, A. F. Macallum, A. L. MacLennan, E. J. Printz, W. Van R. Reynolds, Jas. J. Salmond, T. B. Speight, J. G. Sing, M. Smith, J. Scott, J. F. B. Vandeleur, A. J. Van Nostrand, R. B. Wolsey and C. R. Young.

Canadian Society of Civil Engineers, Toronto Branch.—The above society met last evening in Chemistry and Mining Building at Toronto University. Mr. W. S. Kinnear, chief engineer of the Detroit River Tunnel Company, delivered an interesting lecture on the construction of the Detroit River Tunnel. Mr. A. W. Campbell presided.

Royal Astronomical Society.—Professor Louis B. Stewart of the University of Toronto addressed the Peterborough Centre of the above society on Tuesday, February 22nd.

McGill Science Undergraduates.—The first annual dinner of the Undergraduate Society of Applied Science of McGill is to be held at the Place Viger, Montreal, on Tuesday, March 1. The dinner is expected to be the largest of its kind yet held in connection with McGill.

RAILWAY ORDERS.—Continued from page 185.

9456—February 1—Directing the C.P.R. to repair the embankment known as the Dewdney Dyke, B.C.; and directing the C.P.R. not to cross the Dyke at a greater speed than twenty miles an hour.

9457—January 26—Authorizing the G.T.R. to acquire the necessary land for the approaches to the properties of Mrs. Merrin and John Elliott, and to do the necessary work to carry out the improvements.

9458—February 3—Approving of highway crossing and road diversion in the Northeast Quarter of Section 34, Township 45, Range 21, west 4th Meridian, District of North Alberta, Province Alberta, as applied for by the Grand Trunk Pacific Branch Line Company.

9459—February 2—Approving of the plan of the C.P.R. showing its standard ten-inch stand-pipe.

9460—January 29—Granting leave to the Hydro-Electric Power Commission of Ontario to erect, place, and maintain its transmission wires across the tracks of the Hamilton-Dundas Electric at Lot 55, Con. 1, Tp. of Ancaster, County of Wentworth, Ontario.

9461—February 3—Granting leave to the Bell Telephone Company to erect, place, and maintain its aerial wires across the telegraph lines of the C.N.R. at public highway crossing 270 feet west of Cvrville Station.

9462—February 1—Granting leave to the Hydro-Electric Power Commission of Ontario to erect, place, and maintain its transmission lines across the track of the Woodstock, Thames Valley, and Ingersoll Electric Railway Company at Lot 12, Con. B.F., Tp. West Oxford, Oxford, Ont.

9463—February 2—Approving of the rules of the New York & Ottawa Railway Company, and the Ottawa and New York Railway Company, in so far as they govern the operations of the trains of the said companies in Canada.

9464—February 2—Directing the Toronto, Hamilton & Buffalo Railway Company to cut down and remove the trees growing upon and contained in the triangular strip of land on the south side of the right-of-way at Moote's Crossing, three miles west of Fenwick Station; and authorizing the Toronto, Hamilton & Buffalo Railway Co. to run its trains over the highway crossing without limitation as to speed.

9465—February 4—Approving of road diversions in River Lots 15 and 16, Tp. 46, Range 21, west the 4th Meridian, District of North Alberta, Province of Alberta, as applied for by the Grand Trunk Branch Lines Company.

9466—February 4—Approving of the application of the C.N.R. authorizing the C.N.O.R. to construct a bridge over Goforth's Creek, and to construct its lines and tracks across the public road, Lot 26, Con. 4, Tp. Whitby, County of Ontario, Province of Ontario.

9467—February 3—Approving of application of the Hydro-Electric Commission of Ontario to erect, place, and maintain its transmission wires across the track of the Toronto, Hamilton & Buffalo Railway Company at Lot 55 (part) Tp. of Ancaster, County of Wentworth, Province of Ontario.

9468—February 1—Authorizing the G.T.R. to proceed with the construction of the works provided for in Order No. 8338, dated October 15th, 1909.

9469—February 4—Directing that the pipe proposed to be laid under the tracks of the G.T.R. Company by the Township of Tilbury East, have an inside diameter of at least twenty-four inches (24").

9470—February 1—Dismissing the complaint of the residents of Chambly, Marieville, St. Cesaire, Granby, and Waterloo, in Quebec, complaining of the unsatisfactory equipment of and the irregular train service furnished by the Central Vermont Railway Company and the G.T.R. Company in connection with the traffic offered for carriage upon their respective railways to and from the points named.

9471—February 5—Rescinding Order No. 9298, dated the 18th of January, 1910.

9472—February 5—Authorizing the Grand Valley Railway Company and the Grand Trunk Railway Company to operate their trains over Colborne Street, in Brantford, without being first brought to a stop.

9473—February 5—Authorizing the G.T.R. and C.P.R. to cross the crossing at Drumbo without their trains being first brought to a stop.

9474—February 4—Authorizing the municipality of the village of Carstairs, at its own expense, to construct Minto Street, in the village of Carstairs, across the track of the C.P.R.

9475—February 5—Amending Order No. 8992, dated December 17th, 1909, by striking out clause 1 of the operative part of the Order, and substituting therefor the following:—"1. Install and thereafter maintain an electric bell for the protection of the highway crossing at mileage 1.90; a detail plan showing the layout to be submitted for the approval of an engineer of the Board."

9476—February 4—Approving of the application of the Bell Telephone Company to erect, place, and maintain its aerial cables across the telegraph lines and across the track of the G.T.R. at public crossing, John Street, Port Hope, Ont.

9477—February 5—Authorizing the C.P.R. to use and operate bridge No. 5.5 on the Brownville Section of its line of railway.

9478—February 4—Directing the G.T.R. to construct a subway in the town of Palmerston, Ont., for pedestrian traffic.

9479—February 8—Granting leave to the C.P.R. to construct its Lacombe Branch across the highways from mileage 50 to mileage 85 on the said branch.

9480—February 8—Authorizing the application of the C.N.O.R. to erect, place, and maintain its telegraph wires across the wires of the Bell Telephone Company at the Russell Road, near Ottawa.

9481—February 8—Authorizing the C.N.O. Railway to carry its railway under the wires of the Bell Telephone Company at Station 2.31, town of Parry Sound, Ont.

9482—February 8—Authorizing the town of St. Louis, Que., to carry light and power lines underneath the M. & S. Counties Railway, at the intersection of Front Street, St. Louis, Que.

9483 and 9484—February 8—Authorizing the Hamilton Cataract Power, Light and Traction Company, Limited, to carry power transmission lines across the G.T.R. at Lot 34, Concession 1, and at Beach Division, Lot 34, Concession 1, Township of Saltfleet, Ont., (2 points).

9485 to 9488 Inc.—February 8—Authorizing the Bell Telephone Company to carry wires across tracks of C.N.O.R., C.P.R., and G.T.R., at four different points.

9489 to 9493 Inc.—February 8—Authorizing the Seymour Power and Electric Company, Limited, to carry an electric transmission line across the wires of the North American Telegraph Company at the intersection of Marmora-Stirling Road, and the 2nd line of Rawdon, Ont.; ¾ mile north of Sine, Ont.; ¼ mile north of Sine., Ont.; at a point north of Stirling, Ont.; at a point near Wallbridge, Ont.

9494—February 4—Refusing application of the Canadian Freight Association for variation in Canadian Classification, rating of automobiles "set up," L. C. L., and directing that the Canadian Classification rating of automobiles and other self propelling vehicles, taken apart, (wheels detached), in box cars, L. C. L., actual weight be double first-class. This change to be incorporated in forthcoming amendments to the Canadian Classification.

9495—February 5—Authorizing the C.P.R. to construct a spur to premises of D. Rabbitt, Bawlf, Alberta.

9496—February 8—Authorizing the city of Toronto to lay a sewer under track of C.P.R. on Albany Avenue, Toronto.

9497—February 8—Authorizing C.P.R. to construct industrial spur between Mary and Christina Streets at Westfort, Ont.

9498—February 5—Authorizing C.P.R. to construct spur for the Carter-Halls-Aldinger Company, Limited, Winnipeg, Man.

9499—February 5—Authorizing C.P.R. to extend spur already constructed from a point on the Pheasant Hills Branch from north boundary of the south-east quarter of Section 27, Tp. 29, R. 22, west 2nd Meridian, Sask.

9500—February 10—Authorizing Department Public Works of Government of Saskatchewan to construct crossing over right-of-way and tracks of the G.T.P. Railway on east side of north-east quarter of Sec. 10, Tp. 20, R. 33, west of principal Meridian.

9501—February 10—Authorizing the Bell Telephone Company to carry its wires across the tracks and telegraph lines of the C.N.O. Railway at public highway crossing, McGill St., Hawkesbury, Ont.

9502 to 9504 Inc.—February 10—Authorizing the Manitoba Government Telephones to erect wires across tracks of C.P.R. at public crossing 1¾ miles east of Pettapiece Station, Man.; at public crossing 30 rods west of Pettapiece Station, Man.; at public crossing 4½ miles north-east of Bradwardine, Man.

9505 to 9508 Inc.—February 10—Authorizing the Manitoba Government Telephones to carry wires across C.P.R. tracks at public crossing 1½ miles east of Gautier Junction, Man.; 4¾ miles north-west of Portage la Prairie Station, Man.; at public crossing, 5½ miles north-east of Bradwardine, Man.; at public crossing 3 miles north of Morris Station, Man.

9509—February 10—Approving Rules and Regulations of the Rutland Railroad Company in so far as they govern the operation of the trains of said company, in Canada.

9510 to 9517 Inc.—February 10—Authorizing the C.N.O. Railway to carry its lines and tracks across P. R. between Lots 14 and 15, Con. 4, at station 2064.53; at P. R. between Lots 6 and 7, Con. 3, at Station 1954.15; at P. R. between Lots 5 and 6, Con. 3, at Station 1919.04; at P. R. between Lots 3, Con. 3, and Lot 2, Con. 3, at Station 1890.01; at P. R. through Lot 9, Con. 3, at Station 1990.31, at P. R. between Lots 8 and 9, Con. 3, at Station 1982.08; at P. R. between Lots 10 and 11, Con. 3, at Station 2009.35; at P. R. between Lots 16 and 17, Con. 4, at Station 2093.08; all in the Township of East Whitby, Ont.

9518—February 10—Authorizing C.N.O. Railway to construct a bridge over Orono Creek, Lot 29, Con. 5, Township of Clarke, Ont., at Station 1281.

9519—February 7—Authorizing the G.T.R. for the purpose of making delivery of freight to the C.N.O.R. and its contractors to connect a temporary switch at a line at or near the point referred to in Order No. 9243 in re Township of Scarboro, Ont.

9520—February 3—Authorizing the C.N.O. Railway to construct its lines and tracks across the public road between Lots 22 and 23, Con. 4, Tp. of Whitby, at Station 2179.37, Ontario.

9521—February 11—Authorizing C.N.O. Railway to construct its railway across and to divert the road on Lot 9, Con. "B," Tp. of Murray, Ontario, at Station 1750.

9522—February 12—Authorizing the G.T.P. Railway to divert road in north-east quarter, Sec. 12, Tp. 44, R. 6, west 4th Meridian, Dist. of North Alberta, Province of Alberta.

9523—February 12—Approval of by-law of the Chatham, Wallaceburg and Lake Erie Railway Company, authorizing J. Ernest Richards, General Freight Agent, to prepare and issue tariffs of tolls for the carriage of traffic.

9524—February 12—Authorizing the Hydro-Electric Power Commission of Ontario to carry its transmission lines across the tracks of the Toronto, Hamilton & Buffalo Railway Company, at Lot 55, Con. 1, Tp. Ancaster, Ont.

9525—February 15—Authorizing the Hydro-Electric Power Commission of Ontario to erect transmission lines across the tracks of the Hamilton and Dundas Electric Railway Company at Lot 56, Concession 1, Township of Ancaster, Ont.

9526-27-28—February 12—Authorizing the C.N.O. Railway to carry its lines and tracks across the public road between Lots 18, and 19, Con. 4, Tp. of Whitby; between Lots 32 and 33, Con. 5, Tp. of Whitby; between Lots 34 and 35, Con. 5, Tp. of Whitby.

9529—February 14—Approving location C.N.O.R. from a point between Lots 24 and 25, mileage 173.9, to the line between the Counties of Durham and Northumberland, mileage 177, Ont.

9530—February 14—Authorizing C.N.O.R. to carry its lines and tracks across the public road between the Townships of Clarke and Darlington, Ont.

9531—February 14—Authorizing the C.N.O.R. to carry its lines and tracks across the public road through Lot 26, Con. 4, Tp. of Whitby, Ont.

9532—February 14—Authorizing the C.N.O.R. to carry its lines and tracks across the public road between Lots 34 and 35, Con. B., Tp. of Scarboro, at Station 173.50, Ont.

9533—February 14—Authorizing the C.N.O.R. to construct its lines of railway across the public road between Lots 16 and 17, Con. 3, Tp. of Darlington, at Station 1605.27, Ont.

9534-35-36—February 14—Authorizing the C.N.O.R. to construct its lines and tracks across the concession road between Concessions 4 and 5, at Station 2473.00; across public road between Lots 11 and 12, Con. 4, at Station 2535.08; across the public road between Lots 14 and 15, Con. 4, at Station 2576.64, all in the Township of Pickering, Ont.

9537—February 14—Authorizing the C.N.O.R. to construct its railway across the public road between Lots 7 and 8, Con. 3, at Station 416.04, Township of Hope, Ont.

9538—February 14—Authorizing the C.N.O.R. to use and operate the bridge over the Seguin River on the Parry Sound spur.

9539—February 14—Approving plan, profile and specifications of the proposed drainage works in the Township of Tilbury East, across property of the Canada Southern Railway.

9540-41-42-43-44—February 12—Authorizing the C.P.R. to use and operate two bridges on its Drummondville Section; six on its Sherbrooke Section; one on its St. Guillaume Branch; two on its Newport Section, and three on the Farnham Section of its line of railway.

9545—February 12—Approval of highway crossing and road diversion of the G.T.P. Branch Lines Company in Sec. 22, 23, and 14, Tp. 50, R. 19, west 4th Meridian, Alberta.

9546—February 14—Amending Order No. 9331, dated January 20th, in re application of the municipality of Pointe Aux Trembles, by changing reference to the plan on file and approving plan under File No. 688.19 "A."

9547—February 15—Authorizing the C.P.R. to use and operate Higgins Avenue Subway, Winnipeg, Man.

9548—February 15—Authorizing the C.P.R. to use and operate bridge over the Old Man River and the Lethbridge Viaduct.

9549—February 15—Authorizing the C.P.R. to use and operate Bridge No. 14.6, on the Columbia & Kootenay Section of its line of railway.

9550—February 14—Authorizing the municipality of Kent, Province of British Columbia, to construct highway crossing over the tracks of the C.P.R. at Harrison River, B.C., at their own expense.

9551—February 10—Amending Order of the Board No. 6682, dated the 14th July, 1908, directing the Peterboro Radial Railway Company to install and maintain derails in its tracks and semaphores on the line of the Grand Trunk Railway Company, of Canada, on Charlotte Street, in the city of Peterboro, and changing the system of blocking said derails and semaphores.

9552—February 3—Approving the revised and new locations of the N. St. C. & T. Railway Company from mileage 13.00 to mileage 18.55, Tp. of Humberstone, authorizing the railway company to construct proposed transfer track from the location of its line on Elm Street, Port Colborne, to the siding of the Dominion Government Elevator; to construct a line of railway across Killally and Clarence Sts., Port Colborne; the Concession Road between Concessions 4 and 5; Neff and Thompson Streets, Village of Humberstone; the Concession Road between Concessions 2 and 3; and Main Street West, village of Humberstone, Ont. To cross with its tracks at grade the tracks of the Grand Trunk Railway Air Line and the tracks of the Buffalo-Goderich Division of the Grand Trunk Railway Company.

9553—February 15—Authorizing the G.T.R. to construct a branch line to the premises of the National Manufacturing Company, Limited, Ottawa, Ont.

9554—February 12—Authorizing the Hospital of St. Jean de Dieu, Longue Pointe, Quebec, to carry its electric light and telephone wires under the tracks of the Montreal Terminal Railway, and of the C.N.Q.R. to the said hospital.

9555—February 17—Authorizing the Rural Municipality of Hamiota to carry its telephone wires across the track of the Grand Trunk Pacific Railway at public crossing, 3 miles east of Oakner Siding, Manitoba.

9556 to 9563 Inc.—February 16—Authorizing the C.N.O. Railway to carry its lines and tracks across eight highways in the Township of Clarke.

Ontario. 1—across public road through Orono Station Grounds, at Station 1259.89; 2—across public road between Lots 8 and 9, Con. 4, at Station 961.02; 3—at public road between Lots 26 and 27, Concession 4, at Station 1238.92; 4—at the Concession Road between Concessions 3 and 4, at Station 1147.22; 5—at public road between Lots 35 and 34, Con. 5, at Station 1359.23; at Concession Road between Concessions 4 and 5, at Station 1247.71; at public road between Lots 10 and 11, Concession 4, at Station 990.67; at public road between Lots 23 and 24, Concession 4.

9564—February 16—Authorizing the Atlantic, Quebec and Western Railway to construct a branch line of railway, or siding, from its main line near its terminus at Gaspe onto the proposed Government Wharf at Adam's Bluff, Gaspe.

MARKET CONDITIONS.

Following the quotations of the various articles listed in the markets will be found in brackets numbers, thus (10). These numbers refer to the list number of advertisers on page 3 of this issue and will assist the reader to quickly find the name and address of a firm handling any particular article. Buyers not able to secure articles from these firms at the prices mentioned will confer a favor by letting us know.

Montreal, February 24th, 1910.

It is difficult to make any definite statement with regard to the pig-iron situation in the United States. The market is in an unsettled condition and only a moderate tonnage is moving. The impression seems to prevail that the bottom has been touched and that there is a better undertone to the market. Possibly there may be a slight improvement both in business and in price. The general situation is in no way undermined, and a liberal tonnage continues to go into consumption day after day, but buyers are fairly well supplied and makers are not anxious to sell, the result being a somewhat prolonged breathing spell. Some slight concessions have taken place in price, but, on the whole, the market is firm in tone, and there is little or no selilng pressure. Steel mills are well supplied with orders and specifications are sufficient to keep them all fully occupied. The outlook for structural material is also good, and large quantities will be required for buildings, bridges and extensions of manufacturing plants. Railway companies are not opening up as liberally as was hoped for, but they continue to specify in moderate quantities. It is currently reported that some of the larger railway companies will shortly place good orders for rolling stock and also that they have under contemplation heavy extensions on account of maintenance.

In Great Britain, the pig-iron market has shown practically no change during the past week. Prices are firmly held and reports received indicate a decidedly hopeful feeling, with an upward tendency in price. Certain classes of material, such as steel billets, etc., are difficult to obtain and are held at fancy prices. The general outlook is better than it has been for many months past and the prospects are for a continued good business at higher figures. The German and Belgian reports are very similar to the British, being decidedly optimistic in tone.

Canadian conditions show no cessation from the recent good demand. Consumers of pig-iron and other raw and semi-finished material are urgent in their demands for prompt deliveries. Good orders have recently been placed, covering requirements for the next six or eight months, and specifications against such orders are larger than was anticipated. In fact, the outlook is decidedly bright for the present year. Although there is no boom in the market, the feeling is that it would be just as well to secure supplies at present prices rather than take chances on having to pay more later in the season. Much metal has been purchased for delivery upon the opening of navigation, and buying still continues.

Merchants handling bar iron and steel state that they are looking forward for higher prices in the near future. It should be remembered that higher prices on these lines, as well as on sheets and plates, and all sorts of structural shapes and semi-finished material, have been predicted for months past, and it may be a considerable time, yet, before predictions are fulfilled.

Meantime, the market is exceedingly steady and practically no alterations have taken place in price for some time past. Possibly the approach of spring may bring about the advances spoken of. Meantime, prices are as follows:—

Antimony.—The market is steady at 8 to 8¼c. (111).

Bar Iron and Steel.—The market promises to advance shortly. Bar iron, $1.85 per 100 pounds; best refined horseshoe, $2.10; forged iron, $2; mild steel, $1.85; sleigh shoe steel, $1.85 for 1 x ⅜-base; tire steel, $1.00 for 1 x ⅜-base; toe calk steel, $2.35; machine steel, iron finish, $1.90; imported, $2.20. (111, 119)

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 (164). fibre, 55c. per roll; dry fibre, 45c. (See Roofing; also Tar and Pitch).

Cement.—Canadian cement is quotable, as follows, in car lots, f.o.b., Montreal:—$1.30 to $1.40 per 350-lb. bbl., in 4 cotton bags, adding 10c. for each bag. Good bags re-purchased at 10c. each. Paper bags cost 2¼ cents extra, or 10c. per bbl. weight. (26, 86, 164).

Chain.—Prices are as follows per 100 lbs.:—¼-inch, $4.00; 5-16-inch, $4.40; ⅜-inch, $3.70; 7-16-inch, $3.50; ½-inch, $3.25; 9-16-inch, $3.20; ⅝-inch, $3.15; ¾-inch, $3.10; ⅞-inch, $3.05; 1-inch, $3.05.

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, $2.85 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 14 to 14¼c.

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. (111).

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

Iron.—The outlook is strong. The following prices are for carload quantities and over, ex-store, Montreal, prompt delivery; No. 1 Summerlee, $21.50 to $22 per ton; selected Summerlee, $21 to $21.50; soft Summerlee, $20.50 to $21; Clarence, $19.50 to $20; Carron, No. 1, $21.50 to $22, and Carron special, $21 to $21.50. (111).

Laths.—See Lumber, etc.

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

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

Lumber, Etc.—Prices on lumber are for car lots, to contractors, at mill points, carrying a freight 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 carring $1.50 freight rate to Montreal, $2 to $3. Shingles: Cedar shingles, same conditions as laths, X, $1.50; XX, 2.50; XXX, $3. (112).

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. (74, 188).

Pipe.—Wrought and Galvanized.—Demand is about the same, and the tone is firm, though prices are steady, moderate-sized lots being: ¾-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. (111).

Rails.—Quotations on steel rails are necessarily only approximate and depend upon specification, quantity and delivery required. A range of $30.50 to $31 is given for 60-lb. and 70-lb.; 80-lb. and heavier, being $30; rails, per gross ton of 2,240 lbs., f.o.b. mill. Re-laying rails are quoted at $27 to $29 per ton, according to condition of rail and location. (73).

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). (164).

Rope.—Prices are steady, at 9c. per lb. for sisal, and 10½c. 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. (132).

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. (132).

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 unchanged, at 32½ to 33c.

Zinc.—The tone is steady, at 6 to 6¼c.

CAMP SUPPLIES.

Beans.—Prime pea beans, $1.85 per bushel. (38).

Butter.—September and October creamery, 26c.; dairy, 22 to 23c.

Canned Goods.—Per Dozen.—Corn, 80 to 85; peas, $1.05 to $1.15; beans, 75 to 80c.; tomatoes, 82½ 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.—Late makes, 11¾ to 11¾c.; finest makes, ½c. more.

Coffee.—Mocha, 20 to 25c.; Santos, 15 to 18c.; Rio, 10 to 12c. (38).

Dried Fruits.—Currants, Filiatras, 5¾ to 6½c.; choice, 8 to 9c.; dates, 4 to 5c.; raisins, Valentias, 5 to 6c.; California, seeded, 7½ to 9c.; Sultana, 8 to 10c. Evaporated apples, prime, 9¼ to 9¾c.

Eggs.—No. 1 candled, 26c.; selects, 29 to 30c.; new laid, 35c.

Flour.—Manitoba, 1st patents, $5.70 per barrel; 2nd patents, $5.20; strong bakers, $5.

Molasses and Syrup.—Molasses, New Orleans, 27 to 28c.; Barbadoes, 40 to 50c.; Porto Rico, 40 to 45c.; syrup, barrels, 3½c.; 2-lb. tins, 2 dozen to case, $2.50 per case.

Potatoes.—Per 90 lbs., good quality, 50 to 60c.

Rice and Tapioca.—Rice, grade B., in 100-lb. bags, $2.05 to $3; C.C., $2.00. Tapioca, medium pearl, 4¼ to 4¾c.

Rolled Oats.—Oatmeal, $2.45 per bag; rolled oats, $2.20, bags.

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AMONG THE MANUFACTURERS

A department for the benefit of all readers to contain news from the manufacturer and inventor to the profession.

NEW INCORPORATIONS.

Preston, Ont.—Solid Leather Shoe Company, of Preston, $40,000; J. H. Erb, A. N. W. Clare, C. E. Hurlbut.

Orillia, Ont.—Carss Mackinaw Clothing Company, $40,000; W. Carss, Mrs. J. Carss, A. Carss. Bosancas Cobalt Mines, $1,000,000; J. Boyle, R. J. Sanderson, S. McLaughlin.

Sault Ste. Marie, Ont. — Lake Superior Silver Mines, $600,000; G. A. Blair, R. H. Taylor, C. S. McLachlan.

Sudbury, Ont.—Purvis Bros., $50,000; J. Purvis, L. Fowler, A. D. Meldrum.

Fort Erie, Ont. — Frontier Athletic Association; J. J. Foster, C. W. Sinden, A. B. Sinden.

Chatham, Ont.—Kent Light, Heat & Power Company, $300,000; G. H. Kilmer, J. A. McAndrew, W. H. Irving.

Zurich, Ont.—South Huron Telephone Company, $25,000; E. Zeller, B. A. Campbell, J. Preeter.

Hanover, Ont.—Morlock Bros., $40,000; H. H. Enge, A. Hamel, J. Sandlos.

Winnipeg, Man.—Telegram Job Printers, $25,000; W. L. Roblin, M. E. Nichols, B. F. Sprung. Central Canada Portland Cement Company, $1,000,000; W. A. Fox, v. j. Melsted, Minneapolis; C. Blake, Winnipeg.

Sherbrooke, Que.—Olds Gas Power Company, $5,000; S. F. Seager, Lansing; R. W. Hart, Boston; E. A. Fox, Sherbrooke.

STEAM TURBINE-DRIVEN CENTRIFUGAL BOILER FEED PUMPS.

The first requisite of a boiler feed pump is the ability to give uninterrupted service while receiving little, and often unskilled, attention. For this reason the simple direct-acting pump has long held the field, in spite of its many shortcomings, such as an enormous steam consumption, tendency to produce shock and vibration, unsuitability for close regulation, numerous valves, etc.

The centrifugal boiler feeder, which has lately been taken up by several of the largest steam power plants in the United States, is free of these defects and possesses several important advantages in addition. It does not endanger the pipe line by vibration, by excessive pressure, nor by shock. The inflow of water can be regulated at the boiler without reference to the pump. A centrifugal boiler feed pump contains no valves and only two packings, of quite small diameter, to be kept tight against hot water. There is no danger of breakage of pistons, cylinder heads or packing rings through loss of suction and consequent pounding. The adherents of the direct-acting pump have asserted that with the pump in motion the operator can always be sure that water is going into the boiler, but this supposed advantage does not obtain where one or more pumps are feeding several boilers and, moreover, it is quite possible for a piston pump with one valve displaced to run steadily without forcing water into the boiler.

One thing that has retarded the introduction of the centrifugal boiler feed pump is the fact that it is not suited to reciprocating engine drive, as the comparatively low speed of the latter makes necessary a large number of stages in order to obtain the high heads required to overcome modern boiler pressure and if an attempt is made to keep down the number of stages by making the impeller large in diameter, the efficiency is seriously reduced. However, if the pump is to be driven by a steam turbine or electric motor this becomes an advantage. For instance, the impellers of the two-stage steam turbine driven pump shown by the accompanying photograph, designed to deliver 1,600 gallons per minute against a head of 700 feet at 2,800 revolutions per minute, are quite moderate in diameter.

Both theory and experience show that a small-diameter impeller is capable of higher efficiency than a large diameter-impeller, although correct theory and greater skill are required for its design and better materials and workmanship for its successful production. That the energy losses connected with the impeller can be greatly reduced in one of small diameter will be evident from a consideration of the nature of such losses, which may be divided into two kinds, viz., those occurring within the impeller and those occurring without. The losses within the impeller are similar to the well-known frictional losses of liquids flowing through piping or other passages and with any given velocity of flow are the greater, the longer the passages. That is, other things being equal, they will increase with the diameter of the impeller. The losses having to do with the impeller, but occuring outside of it, are similar to the losses encountered when a ship is forced through the water. Now, since to generate a given head the periphery of the impeller of any centrifugal pump must, within narrow limits, run at a certain fixed velocity, and equal areas running at the same velocity in frictional contact with the water will dissipate equal amounts of energy it will thus be seen that the smaller impeller, as a whole, will dissipate much less energy since the area of exterior wetted surface moving through the water is greatly reduced. In fact when generating a given head this loss is found to vary about as the square of the diameter of the impeller.

The impeller of the pump here illustrated is of bronze, of a character found to resist the corrosive action of hot water, an important point since the least roughing or pittting of the impeller rapidly diminishes the efficiency of the pump.

A further notable feature of the present pump is the absence of guide vanes. Guide vanes were originally introduced to improve the mechanical efficiency of the old-style centrifugal pump, and in this they were often successful, due to the poor design of the latter. However, unless such vanes are made adjustable, which has never been done in pump practice, they can be of assistance in transforming energy of velocity into static energy of pressure only at one given output of the pump. At any other output the diffusion blades do not take up the water tangentially, are in the way, and therefore produce shock and commotion. In any case the diffusion passages increase the amount of wetted surface in contact with water at high velocity. To give the best results they should be finely shaped and should terminate close to the impeller, which disposition, however, is found to result in rapid erosion of both guide vane and impeller blade tips, also in jamming and destruction of blades by solid substances carried in the water. Again, in order to use diffusion blades it is necessary that the casing of the pump should hug the impeller closely, which naturally increases the viscous drag of the water upon the impeller.

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(Continued from page 191.)

Tea.—Japans, 20 to 38c.; Ceylons, 20 to 40c.; Ceylon, greens, 19 to 25c.; China, greens, 25 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.—$30 to $32 per bbl.; beef, $15 per bbl.; smoked hams and bacon, 15 to 18c. per lb.; lard, 17c. for pure and 12c. for compound. (38).

* * * *

Toronto, February 24th, 1910.

Cold weather has been fairly steady for weeks in Ontario, and snow plentiful. This cannot be said to have helped building operations; and yet building has been fairly active, especially in the large cities. Winnipeg is likely to have a remarkably active spring and summer in building, Toronto likewise. In most of the United States the prospect is for a record-breaking building year in 1910, contracts already made there for spring are unusual in both cities and towns.

The metals trade has continued fairly active, iron and steel prices continuing steady. Foundries are busy, as a rule. Tin has been irregular outside by reason of speculation, but is not quotably altered here. Copper has witnessed much speculation in Britain and the States, and large quantities have been moving. Lead and antimony are maintained at former figures. Demand for lumber keeps up well, good pine commanding firm prices because scarce. Cement and brick quiet. Tarred paper and roofing felt steady, with good spring prospects.

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

Antimony.—Demand quiet at 9c. per 100 lbs. (111).

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. Market supply limited. (111).

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 lbs.

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, $10.60; 3-inch, $11 to $11.50; 3½-inch, $18 to $18.50 per 100 feet.

Building Paper.—Plain, 27c. per roll; tarred, 35c. per roll. Demand is good for spring requirements.

Bricks.—A very active season has closed, and prices are as below. Prospects excellent for business in 1910. 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. Not much doing. Broken granite is selling at $3 per ton for good Oshawa. (164).

Cement.—The figure of $1.60 may still be quoted at Toronto in car lots per barrel without bags. A large contract recently closed by the city was at $1.57. In smaller parcels $1.70 is asked by city dealers, plus bags, (26, 86, 169).

Coal.—Retail price for Pennsylvania hard, $7.25 net, steady. This price applies to grate, eggs, stove, and chestnut; only pea coal is cheaper, namely, $6.00. These are all cash, and the quantity purchased does not affect the price. In the United States there is an open market for bituminous coal and a great number of qualities exist. We quote. Youghiogheny lump coal on cars here, $3.70 to $3.80; mine run, $3.60 to $3.75; slack, 2.65 to $2.85; lump coal from other districts, $3.40 to $3.70; mine run 10c. less; slack, 2.50 to $2.70; cannel coal plentiful at $7.50 per ton; coke, Solvey foundry, which is largely used here, quotes at from $5.75 to $6.00; Reynoldsville, $4.90 to $5.00; Connellsville, 72-hour coke, $5.50. Soft coal and slack are scarce.

Copper Ingot.—The consumption is larger than ever, but production may be said to beat the record. Such conditions afford play for the speculators. Price here, 14½c. per lb., and the demand active.

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

Dynamite, per pound, 21 to 25c., as to quantity. (83.)

Felt Roofing.—A good prospect for spring trade 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; ¾-inch, $4.15; 7-16-inch, $3.05; 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, $39.85; 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. (74, 188).

Lead.—An active demand at previous prices, which are $3.75 to $3.85 per 100 lbs.

Lime.—Retail price in city 25c. 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.—Prices are generally firm, especially in pine. We quote dressing pine $32.00 to $35.00 per M; common stock boards, $26 to $30; cull stocks, $20; cull sidings, $17.50; Southern pine dimension timber from $30 to $45, according to size and grade; finished Southern pine according to thickness and width, $30 to $40. Hemlock in car lots, $16.50 to $17; spruce flooring in car lots, $22 to $24; shingles, British Columbia, are higher, we quote $3.10; lath growing scarce and stiffening, No. 1, $4.40, white pine, 48-inch; No. 2, $3.75; for 32-inch, $1.60.

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 dull at $3.50 per barrel. This is the dead season.

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.—Little doing; 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.

Pig Iron.—There is great activity and prices are maintained. Clarence quotes at $21 for No. 3; Cleveland, $20.50 to $21, Summerlee, for winter delivery, $22.50 in Canadian pig, Hamilton quotes $19.50 to $20 per ton. Producing plants are everywhere busy, and there is considerable business in prospect for 1910.

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

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

Sewer Pipe.—

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

Business quieter; price, 73 per cent. off list at factory for car-load lots; 65 per cent. off list retail. Small lots subject to advance. (52, 84, 138).

Steel Beams and Channels.—Quiet.—We quote:—$2.50 to $2.75 per 100 lbs., according to size and quantity; if cut, $2.75 to $3 per 100 lbs.; angles, 1¼ by 3-16 and larger, $2.50; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees. (30, 41, 50, 4, 176, 127, 132, 145, 118, 119).

Steel Rails.—80-lb., $35 to $36 per ton. The following are prices per gross ton, for 500 tons or over; Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.

Sheet Steel.—The market continues steady; 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, $2.50; 26-gauge, $2.65; 28-gauge, $2.85. Quite a good demand exists, and there is prospect of higher prices.

Sheets Galvanized.—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $2.90; 12-14-gauge, $3.00; 16, 18, 20, $3.10; 22-24, $3.25; 26, $3.40; 28, $3.85; 29, $4.15; 10¾, $4.15 per 100 lbs. Fleur de Lis—28-gauge, $4; 26, $3.80 per 100 lbs. A very large tonnage of all sorts has been booked. The feeling is toward an advance. (111).

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. (4).

Tin.—There has been much speculation in London, but the recent level of prices has shown some disturbance. Quotations here, 34½ to 35c.

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. (132).

Zinc Spelter.—A very active movement continues, and a large business is being done. Price as before, $5.75 to $6 per 100 lbs.

CAMP SUPPLIES

Butter.—Dairy prints, 23 to 24c.; creamery prints, 29c. per lb.

Canned Goods.—Peas, $1.10 to $1.50; tomatoes, 3s, 85c. to 95c.; pumpkins, 3s, 80 to 85c.; 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. (38).

Carrots.—60c. and 65c. a bag.

Cheese.—Large, 12¾c.; twins, 13c.

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

Dried Fruits.—Raisins, Valencia, 5½ to 6½c.; 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, 8¼ to 9c.; uncleaned currants, ¼c. lower than cleaned. California Dried Fruits.—Evaporated apricots, 15 to 16c. per lb.; prunes, 60s to 70s, 7 to 7½c.; 90s to 100s, 6½c.; evaporated apples, 8c. (38).

Eggs.—Cold storage, 28c.; new laid, lower, at 30 to 31c. per dozen, in case lots.

Flour.—Manitoba Flour.—Quotations at Toronto are:—First patents, $5.60; second patents, $5.10; strong bakers', $4.90; 90 per cents., Glasgow freights, 28s. 6d. Ontario Flour.—Winter wheat patents, for export, $4.20 to $4.25, in buyers' sacks outside.

Lard.—Tierces, 15½c.; tubs, 15¾c.; pails, 16c.

(Continued from page 192).

One of the chief obstacles to high head per stage in certain types of centrifugal pumps has been the leakage from the discharge, past the impeller, back to the suction chamber. In this pump this has been prevented by the use of special labyrinth packing rings, instead of the plain, straight, water packed joint commonly employed. At each joint there is one labyrinth ring attached to the impeller and another meshing with it set into a recess in the pump casting and secured in place by the act of letting the cover down upon the lower pump casing. The two labyrinths intermesh in such a way as to form a long, tortuous passage in which any leakage currents are repeatedly broken up. At the same time the water within the labyrinth is set in motion by the drag of the moving ring, creating a counter centrifugal force in opposition to the leakage. A packing of this nature permits of much greater clearance in both radial and axial directions at once than does a straight water-packing, and furthermore, it lasts longer, as the velocity of the water through it is much less.

Simplicity of construction and accessibility for inspection are essentials for any pump that is to be installed in a boiler room and entrusted to unskilled labor. It should be possible to get at the working and wearing parts of a pump without disturbing pipe connections. The casing of this pump consists of two parts only, the bottom casting and the cover casting. In the bottom casting are formed the inlet and outlet passages to the piping, while both castings contain passages leading from the delivery of the first impeller to the inlet of the second, these passages being cast in the solid metal. Smoothness and exact form of the passages are secured by the use of dry sand moulds exclusively. The top or cover casting, when raised, exposes the shaft and the impeller, that is the entire interior and all working parts of the pump, and after removing the shaft bearing caps, the impeller may be lifted out entire, so that all parts are rendered accessible by the breaking of only one packed joint, namely, that between the two halves of the main casting. The connections to the suction and discharge pipes need not be disturbed in any way. The flange of the suction opening may be seen at the end of the pump under the bearing, while the discharge opening is directed horizontally on the farther side of the pump.

The bearings of a boiler feed pump destined to be operated for long periods without attention should be the best obtainable. In the present case they are all of the ring-oiled type used for electric motors and generators. They are of very ample dimensions and are supported on hollow brackets or pedestals entirely separate from the pump casting. These pedestals contain oil wells and are fitted with the usual cocks and gauge glasses.

While the impellers are in perfect hydraulic balance, one of the bearings is made of the marine thrust type in order to take care of any end thrust that might be developed by possible clogging of the balancing passages in the impellers. A few words in explanation of the method of balancing may be of interest. On the rear side of each impeller, that is the side opposite from the inlet, is a chamber encircled by the labyrinth rings and of the same diameter as the inlet chamber. This balancing chamber is connected to the inlet by a small hole through the impeller disc itself. It therefore contains water at the same static pressure as the water entering the impeller, and any reaction due to the entering column of water is balanced by an additional static pressure generated by the impact of this entering column of water on the small holes connecting the two chambers.

Leakage of water outboard around the shaft at the discharge end of the pump or leakage of air into the suction side of the pump are prevented by packing glands, which in addition to packing material under pressure, have a central open part to which water under pressure is introduced, effectually preventing the entrance of air. As pump shafts are sometimes injured by excessive friction and scoring due to improper use of the wrench on the nuts in drawing up the followers of the packing glands, and also to protect against corrosion by water, the shaft is protected by bronze sleeves extending from the outside packing up to the impeller. In case of scoring or erosion of this sleeve it can be replaced without renewing the shaft. Leakage of water around the shaft where it passes through the diaphragm separating the two stages is prevented by a long bronze-lined water-packed joint in which there is no rubbing contact.

The pump is directly driven through a flexible coupling by a steam turbine upon the same bed plate. The turbine is designed to receive steam at 200 lbs. gauge pressure with 150° F. superheat, and to exhaust into open heaters. The power for operating the pump, therefore, costs practically nothing, as all of the energy of the steam is returned to the boiler in the feed water, including even that expended as work and friction in the pump and turbine.

The governor of the turbine is an interesting feature. The pump can be controlled by an ordinary pump governor, of either the constant or excess-pressure type, inserted in the steam line ahead of the turbine, the turbine governor acting merely as a maximum speed limit. The turbine governor is driven by a worn gear from the shaft at a speed of 900 revolutions per minute, making possible the use of a heavy, powerful construction. As an additional guarantee against excessive speed, an emergency governor is fitted to the end of the shaft. In case of overspeeding this governor trips a level, which relieves steam pressure from under a piston controlling the emergency valve in the steam pipe outside of the turbine The pipes connecting the emergency governor and the emergency valve may be seen. Even in the case of failure of both governors the turbine could suffer only minor damage, as the wheel is so designed that long before its limit of strength is reached, the buckets will fly off, upon which the disc will come to rest. The single solid disc of this turbine is comparatively easy to balance, although it is quite difficult to balance a shaft with several discs threaded on it.

In a turbine of this type the best steam economy is secured when the nozzles are receiving steam at the full pressure. In order to make possible the running of the nozzles at the highest efficiency at all times, including periods of light load, it is only necessary to supply hand or automatically operated valves for shutting off one or more nozzles as may be required. Such valves may be observed at the top of the machine.

Where the amount of exhaust steam available in a plant is more than is required to heat the boiler-feed water up to 210 or 212° F., these turbines admit of being run with exhaust steam from other auxiliaries, exhausting into the main condenser, or they can be arranged for mixed flow, that is, with certain nozzles designed to receive live steam and others to receive exhaust steam.

The machine here described and illustrated is one of two shipped to the Detroit Edison Company by the De Laval Steam Turbine Company, of Trenton, N.J. The pump has shown under test at full load an efficiency of over 60 per cent., which, considering the capacity is unusually high. Larger pumps of this type and make have shown efficiencies above 85 per cent.