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The Canadian Engineer

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ESTABLISHED 1893

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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, OCTOBER 29, 1909.

CONTENTS OF THIS ISSUE.

PUBLIC COMPETITION.

A Canadian municipality is calling for competitive designs for a large public work.

It is to be hoped that professional men will set themselves against such methods of securing plans and specifications. For a thousand dollars the municipality will secure three thousand dollars' worth of information, and a large number of men will work up good plans, spend much time and energy, and will not receive one dollar.

A certain amount of competition may be necessary to keep alive and bright any body of men, but when it comes to working for months for nothing—sometimes even to have your plan or design stolen, great injury is sure to follow.

Municipalities should select their consulting engineer or architect and allow him to work out the best possible solution of the problem. Anyone of a dozen of the leading engineering firms could give this municipality a more workable and suitable plan than they will get in a competition.

If this municipality asked six firms to build six sections of sidewalk, promising to pay the firm that did the best work for one-half of all work done, how many firms would do work for them?

The scheme of competitive plans is just as unreasonable as this.

Engineers would do well to set their faces against a continuation of such practices.

THE GRAND RIVER IMPROVEMENT ASSOCIATION.

It is to be hoped the organization of the Grand River Improvement Association will stimulate other sections of Canada to take an intelligent interest in such matters as the prevention of stream pollution, excessive runoff, and the beautifying of our river valleys.

The idea of such organizations is a good one, and Mr. W. H. Breithaupt, C.E., is to be congratulated upon having been successful in persuading the people along the Grand River to unite in an endeavor to investigate the causes of pollution and flooding, and assist in remedying undesirable conditions.

There are many streams in our older settled districts that years ago were fairly regular in flow and pure in water supply that are now sources of danger to the community, and the stream valley very unpleasing to the eye.

Such associations as this is will very much improve conditions, and we hope more will be organized. Mr. Breithaupt has done a great public service in educating the people in the neighborhood of the Grand River as to the possibilities of that stream, and his work there will be felt all over Canada.

SERVICE OUR AIM.

A publishing house can find no end of branches which it may exploit in the hope of finding new and profitable business. Many departments are opened with that object in view. Not so this new department of The Canadian Engineer—the Information Department. It is opened solely with the view of giving quicker and surer information to employers and employees.

During the past year we have been able to furnish men for many different kinds of work in every part of Canada. If we had been provided with the information we could have placed twice as many men.

Then again, there are many men holding positions that are not to their liking. They do not hear of the openings, and when openings occur no one has a record of suitable men for the work. We hope to fill the want.

In a short time this department will have information that will make it possible to select a man for any vacancy. To-day we have four vacancies in different branches of engineering for which we cannot provide men because we have not a record of the men.

If you think we can help you, and you are an advertiser or a subscriber, let us send you a blank.

THE BRITISH VIEW OF COLONIAL CONTRACTS.

(The Contractors' Record, England.)

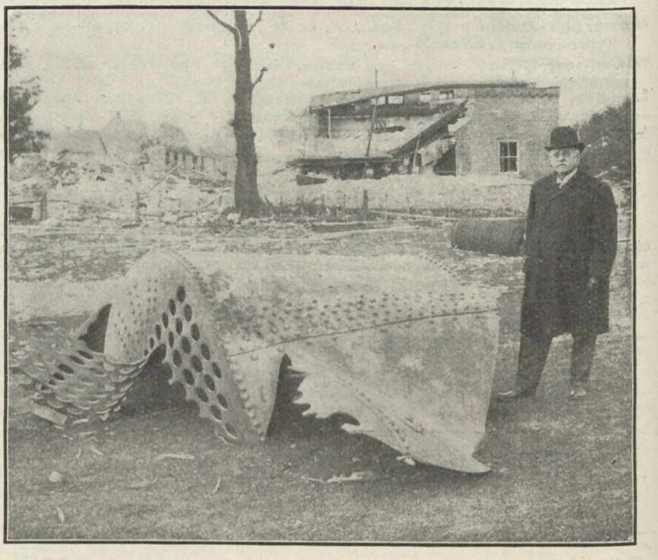
A great deal of shouting has been indulged in concerning the work which ought to be secured by contractors in this country from the colonies, but whilst obstacles exist, rendering it almost impossible for proper tendering, very little real benefit is secured, except, possibly, to those who do the shouting. Proofs continue to reach us of the need for more time in which to tender upon large contracts. We refer more particularly to important municipal and Government work. Possibly there are many who find that in most cases the usual time limit is amply sufficient for their own purposes. With such, these considerations will find little favor. There are different ways of looking at every case. Probably these firms are either right on the job, or have little difficulty in getting a representative there. But what about the men who depend upon the press for their advice of contract work to be done in the colonies? There is very little chance for them within the limits already allowed for tendering. In the course of a season, for instance, great quantities of cast-iron and other pipe and all kinds of materials are needed by the various municipalities throughout, we will say, Canada, in connection with waterworks, sewerage, and general improvement work. To whom are these contracts generally awarded? In most cases to Canadian or American firms. Now, in these competitive days, when it is a maxim in municipal as in individual affairs, to get the best value at the lowest cost, it is manifestly unfair to bar any good competitor by not giving him sufficient time to tender. It is poor consolation for the British competitor, for instance, to know that he can get his goods into the country upon more favorable terms than the American manufacturer, and be forced to realize at the same time that in ninety-nine cases out of a hundred he is handicapped right out of the running by inability to deliver his tender within the specified time. There is a certain amount of humor in the situation, but there is something far more unjust in it than there is funny. Of course, there is but one sequel, in so far as the British contractor is concerned. He gives up all idea of tendering on Canadian work. We contend that any work which involves the expenditure of a large sum of money should be advertised within such a duration of time as to allow British firms to make some investigation, and submit a proper estimate. Inadequate notice of projected work means limited competition, ill-considered estimates, and many other resultant evils, apart from the injustice perpetrated on the long-suffering individual who foots the bill.

BOILER EXPLOSION.

On the evening of October 12th the boiler in the Aylmer electric light and water plant exploded and wrecked the plant, spreading fire into the adjacent buildings. The engineer in charge was killed.

The boiler, which was of a hundred horse-power, and was situated at the west end of the building, had been recently overhauled and was inspected a week or two ago. This was the first time that it had been used since it was renovated.

The wreck of the building was complete. When the explosion occurred the boiler was literally torn in two. The western half went through the side of the building, and was carried over a hundred and fifty yards, completely demolishing the footbridge across Catfish Creek. The other half flew through the east end to a distance of three hundred yards. A piece of the boiler struck the top of the standpipe of the waterworks, knocking it off. The loss will be about $35,000.



Building and Boiler after the Explosion. This 4,000 Pounds' Boiler thrown 300 Feet.

At the inquest the chief witness was Mr. F. Mitchell, of the London Engine Supplies Co., who gave expert testimony. He said there had been no burning of the flues or any part of the boiler. There had been no low water, and the explosion, in his opinion, had been caused by a weakness in a plate, which was cracked. There were two boilers in the plant, and they were used alternately. This meant that this boiler would be hot and cold by turns, and the constant contraction and expansion had aggravated the original trouble. Also, the crack in the boiler was situated underneath a spot which the boiler inspector, making his semi-annual inspection, would be unable to see.

Chief Electrician Millard said he had examined the boiler on October 5th last, and that it was then in good condition. It was carrying 80 pounds of steam, and any repairs made were of a simple nature.

In returning their verdict the jury place no blame upon anyone. The explosion had been caused by a defect in the boiler, which could not be seen unless the whole boiler was taken to pieces.

THE HISTORY, DESIGN AND CONSTRUCTION OF ELEVATORS.*

J. H. Shales.†

There are several designs of elevators, but only three types operated by either steam, water or electricity, steam being the earliest power used in the lift, as it is called in the old lands. The first used for passenger service was at the Crystal Palace in London about 1851, it being a very crude affair, with chains instead of wire cable from drum to car. The first hydraulic machines used in America were invented by the late Charles Otis about thirty-five years ago, from which we have the different designs now in use, and of which the plunger is the best.

By way of explanation, a plunger elevator is a new thing for the skyscraper. Yet it is the oldest kind of elevator in the world, but very few engineers ever thought it would be introduced into the twenty-storey office building. After having been proved a great success in other cities, it is coming to New York very fast. The method of boring the shaft is one of the marvels of the modern engineering age.

A shaft is started by setting up a short section of compressed steel piping. This is notched on one end, like a saw blade. It is attached to an electric motor and set revolving. As it cuts down into the earth steel shot are poured down and allowed to settle around the saw teeth on the end of the steel piping. A stream of water is then forced down to assist the grinding, and gradually the revolving pipe, with its saw-like teeth, assisted by the steel shot, bore deep into the earth. The hardest stone can be penetrated. In fact, any hard substance can be cut through with apparent ease. When the first section of piping has been sent down another is screwed on, and so the circular shaft is sunk. The core, whatever it may be—stone, clay, sand or water—comes up through the piping or caisson and is carried away.

It was while sinking one of these shafts the Otis Elevator Company encountered at 47 Maiden Lane, where the S. F. Myers building is in course of construction, a very thick layer of hard granite. When the core was finally pulled out of the caisson it was found to be 16 feet long. This is the longest solid rock core ever taken out in Manhattan, and it goes to show that the thickest layer of rock forming the foundation of Manhattan Island is in the down-town district of New York.

The Standard Elevator Company have eleven plunger elevators in the Trinity Building. These are the longest plunger elevators in the world. Eleven shafts, each 285 feet, have been sent down below the graves in Trinity Churchyard. They are used to support the cars of elevators which supply the big office building, and if they prove successful the superiority of the plunger elevator over the cable elevator will probably be established not only to the satisfaction of the engineers, but to the capitalists who furnish the money to build the modern skyscraper.

There are two designs of elevators that cannot be overlooked: First, the Sprague screw machine, which is in common use; and second, the Duplex or Fraser differential elevator.

The former is much like the horizontal hydraulic machine in operation, having no drum. The motor revolves on a long screw, on which travels a ball nut, and this nut moves the travelling sheaves. The operation of this elevator is very smooth, but the cost of repairs has to a large extent prevented its success.

The Duplex machine, on the other hand, might be said to be in its infancy, as only a few of them have been installed so far. It consists essentially of two motors, mounted one above the other, each having a driving pulley or sheave on the end of its shaft, around which the driving ropes run. The car is suspended from cables, which, after passing over the main overhead sheaves, are attached to the counterweight. From the top of the counter-weight frame ropes are carried over another overhead sheave and down to counterweight device, on which is mounted the tension sheave. The driving ropes run from the upper driving sheave over a sheave attached to the bottom of the counter-weight, thence around the lower driving sheave and over tension sheave and back to upper driving sheave.

The driving ropes are continuous, and as long as the two motors run at the same speed the various sheaves revolve in their places and the car stands still. As soon as the relative speed of the motor changes, the counter-weight is raised or lowered, and the car moves correspondingly. This kind of elevator can attain the high speeds of the hydraulic elevators, as the motors are not stopped in stopping the car. The car-switch controls two rheostats, one in the field of each motor, and the field of one is weakened while the other is strengthened as the car-switch moves away from the central position. In the central position of the switch both fields are alike, and the motors run at the same speed. The ease and rapidity with which these elevators are started and stopped is wonderful. In this respect they are superior even to hydraulic elevators. Of course, the continuous operation of the motors means a greater power consumption, but this is largely offset by absence of starting current and the time saved in handling passengers. You may notice that I have not mentioned either automatic residence elevators or alternating current elevators, but the omission is intentional. The automatic, with push-button control, offers an interesting study, but is used, of course, almost exclusively in private houses, and hence you would have no occasion to deal with it.

In regard to alternating current elevators, there are some inherent faults which have not yet been overcome.

In an office building which I visit there is an alternating current elevator, which manages to keep running and carry passengers, but the tenants all know when it starts. It emits first a low groan, which rises rapidly to a high-pitched humming sound, and maintains this until the car stops.

Of the first importance in connection with elevators are the safety devices. On the high-grade drum type machine we have, first, the main brake, which is raised by a solenoid, and consequently acts not only when released from the car-switch, but whenever current fails from any reason what-

* Read before the Central Railway and Engineering Club, Toronto.

† Consulting engineer, Elevator Specialty Co., Toronto, Ont.

soever. Second—We have the stop motion switch, which is operated by a travelling nut on an extension of the drum shaft, and stops the elevator at either limit of travel by means of a switch, which is practically a duplicate of the ear-switch. Third—The potential on the controller, which opens and cuts off current if the line voltage drops or whenever the slack cable or limit switches open. It is also operated by the ear-switch as heretofore described, and similarly by the stop motion switch. Fourth—The slack cable switch is usually located underneath the drum, and is opened mechanically whenever one of the cables becomes slack. This opens the potential switch circuit, stopping the machine. Fifth—Limit switches in shafts are so placed as to be opened by the car when it exceeds its normal limit of travel. They open potential switch circuit as before described, and act as a check on stop motion in case it gets out of adjustment. Sixth—Safety switch in car, which opens operating line, and hence potential switch, and shuts down elevator. This is for the benefit of the operator if car-switch should stick.

Where an emergency brake is used, safety switch operates this. Seventh—An auxiliary emergency brake is used on large machines, which acts when all circuits are opened from car-switch or main current fails. This gives increased mechanical braking at a time when dynamic braking action would fail. Eighth—Car safety, which is controlled by centrifugal governor and grips rails, stopping car at any predetermined speed.

The best form consists of a ball governor at top of the shaft, which grips governor rope at excessive speed. Governor rope is attached to car by a spring plug, which pulls out readily. A second rope is fastened to governor rope and then wound round the drum of the safety plank. When the governor rope is gripped, this rope unwinds the safety drum, and by means of right and left screws and toggle joints or wedges forces jaws of safety together until they cramp the rails hard enough to stop the car.

The governor sometimes operates a switch to stop the motor before grips go on. Ninth—An air cushion is sometimes used as a last resort, if everything else fails. Tenth—Slow-down switches in shaft are often used. They may automatically cut in an auxiliary shunt, winding on the motor as the car nears the upper and lower landings, so that limits of travel are approached at slow speed.

Although so many safety devices are required, they are comparatively simple in themselves and positive in operation. The general cause of accidents is the abuse of or neglect to care for them. Of course, you all know that trouble and accidents have occurred on all makes. It may be worth while to discuss them briefly and the means of prevention.

In the first place, there are a great many contacts about the controller of an electric elevator, and it is essential that they be kept clean and in proper adjustment. Contact pieces that have to carry heavy current should have ample bearing surface, and where such contacts are used to break currents they should have auxiliary carbon contacts, between which the final break and consequent arc occur.

In the controller of which I have spoken copper discs are used and set loosely on their spindles, so that they rotate during operation, and constantly present new surfaces to the contact pieces. A judicious use of emery cloth will keep these in order for a long time. Knife contacts, however, are very bad. I remember one time when I was called in to investigate an elevator accident. The controller was a cheap solenoid affair, with a double lever arrangement. The car rope turned a shipper sheave, which moved a lever and threw in the main switch, which in turn connected the solenoid and started the motor, the solenoid gradually cutting out the resistance. The switch blades happened to get bent and passed their clips, making a poor contact. The arcing set up fused the blades solidly to their clips, and the operator could not pull hard enough on shipper rope to release them.

The car came on down to the bottom, and as soon as the ropes slacked the mechanical slacked cable device was brought into play. This merely threw a clutch into gear with a pinion, meshing with a rack on the same old lever, and, as the switch blades still refused to let go, the gear was stripped of its teeth, the lever bent and the controller board smashed. The main line fuses blew out at this point and saved the rest of the wreck.

There were two bad features in that elevator: knife contacts and a mechanical slack cable device. The remedy prescribed was a new and better controller. Great care should be used to keep wires from becoming crossed or grounded, as almost any combination of circuits can be obtained by grounding wires, and it is impossible to foretell the result.

I know of one case where an armature grounded and a sudden flash occurred clear across the commutator. The startled attendant grabbed a fire bucket and threw its contents on the motor. It put out the fire, but it pretty effectually put the motor out of business and cost a new armature.

Another thing: If you disconnect the field terminals, be sure to get them back right. If you get the series field in opposition the motor will surely run away. Even a loose connection in the field circuits may cause trouble.

It is well to remember, too, that the ear is overbalanced for the sake of economy, and if you jack the brake off while making some repairs, and at the same time have the main switch open, the car had better be at the top of the shaft; otherwise it will soon get there, and it might not stop at the roof.

A great many accidents in which people have been hurt have been due to the car over-running the lower limit and breaking the counter-weight ropes at the top of the shaft and dropping the weights on the people below, when they would not otherwise have been hurt. This is easily prevented by having the weights securely bolted together by through bolts.

Sometimes hoisting ropes break and the car safety fails to operate. This cannot occur with a good governor, kept in proper condition. It would seem superfluous to say that all moving parts should be kept clean and well lubricated, and yet most of the wear and tear and a great deal of trouble is due to just this lack of attention. All the cables, but particularly the hoisting ropes, should be carefully inspected frequently, and if the wires of the latter show signs of cracking the ropes should be discarded. If they show wear on one side, observe how they lead from drum to sheave, or in case of B.D. ropes, from drum to vibrator. See that the vibrator shaft is so clean and well lubricated that the vibrator follows easily and does not lag behind, pulling the ropes off to one side.

I will touch on just one more point. The electric elevator in small buildings offers marked economy over other forms. No steam plant has to be run for its benefit, and it uses power only when it is in operation, and then proportionately to the load carried. With average load, it takes only the power required to overcome frictional and motor losses. In general, you might expect an automatic residence elevator to use about 1.6 k.w.h. per car mile, and a big passenger machine for a large office building about 3 k.w.h. per car mile.

The Duplex machine has not been thoroughly tested, but while using about the same current in operation, undoubtedly averages somewhat more, due to its constant running motors.

THE VALUE OF EXPERT INVESTIGATION.

Reference has frequently been made to the good work accomplished in the exposure of graft by the original Boston Finance Commission, which recently completed its labors. Hon. Nathan Matthews, chairman of that Commission, has, however, pointed out that this part of the work was incidental only to the real work of the Commission, namely, the investigation of the conditions, facts, costs and methods which have made the city government of Boston the most expensive in the world and one of the least efficient. The service rendered by this Commission is indicated not so much by public hearings and disclosures of graft as by the two hundred odd reports submitted by the Commission and its engineers to the city government. Whatever may be the permanent value of this work, it at least differs from that of other municipal investigations in being a detailed study and criticism of actual methods, conditions and facts.

The Commission in the beginning recognized the necessity and great value of expert investigation, upon which its general conclusions might be based. They were fortunate in securing the services as consulting engineers, of the firm of Metcalf & Eddy, of Boston, whose fifty-nine reports in the form of a volume of over 1,200 pages have just been published. Especial value is given to these reports by the standing of the firm by which they were made.

It is manifestly impossible to present in a few words the results presented in such a stupendous piece of work, but a few examples cannot fail to be of interest. The magnitude of municipal waste is manifest in the estimate of the experts that in 1908 the losses resulting from the carrying of unnecessary employees, the performance of work which should have been done by contract instead of day labor, the inefficiency of labor and improvident contracts were not less than $1,900,000 in five departments alone, the street cleaning and watering, sanitary, sewer, water and paving departments.

The sewer department spent $1,384,347 in 1906-7 and $1,240,709 in 1907-8. There was an utter lack of discipline over the employees, favoritism in the award of contracts prevailed, excessive prices were paid for contract work, and there was a further loss in the failure properly to inspect the work. Some employees had enough influence to procure reinstatement after discharge; others got transfers from strict foremen to lenient ones, and others procured positions which required no mental or physical effort.

The financial result of the construction work of the sewer department, as admitted by the superintendent, his chief engineer and his deputy, was a loss to the city of from 25 per cent. to 150 per cent. of the proper cost of the work.

For many years stone had been crushed by the department at an excessive cost. Between 1897 and 1906 the average cost of stone to the city at the crusher plants operated by the city was $1.60 per ton. In 1906 it was $2.85, and in 1907 it was $3.24 per ton. The fair market price, f.o.b. cars in Boston, did not exceed $1.10 per ton. Although the mayor had been advised by the executive engineer of the department to discontinue this work, he refused to do so, and the aggregate loss to the city in these two years from this cause was about $179,000.

The cost of laying pipe in the water department was found to have been from 50 to 150 per cent. in excess of the cost of similar work in neighboring cities. The cost of hydrant maintenance in winter was twice what it was in Brookline, and nearly twice as great as in Chelsea or Worcester.

It was shown that on a basis of $2,500,000 spent nominally for sewer or waterworks construction $1,750,000 is the fair cost of the work, and $500,000 in addition is spent for superfluous labor and $250,000 more in excess prices for contracts and purchases, entered into without competition with favored individuals. It is easy to see that all sections and classes of the community, laborers as well as property owners, are defrauded out of $750,000, or 30 per cent of the entire outlay.

HOW BOSTON WASTED A MILLION DOLLARS.*

"It having been shown by the expert investigation of an independent engineer that the city stone-crushing plants had been operated at an annual loss of about $100,000, the Commission recommended their abandonment.

"But the subject was reopened by the mayor in a letter to the Commission, stating that 'at the behest of certain city employees, who professed their confidence at their ability to turn the present tide of extravagance in the operation of stone-crushers, I gave them a promise that for a limited time I should allow them the use of one crusher for experimental purposes . . . I shall appreciate the favor if you will have Messrs. Metcalf & Eddy detail an employee for special supervision of the work on the ledge, in order not only that we may both have information first hand, but also that there will be no question as to its reliability."

This request was immediately complied with. The best men in the department were selected to run a three months' test on the most economical plant owned by the city. Nearly nine thousand tons were crushed at a total cost, including interest and depreciation of slightly over $9,000, the unit cost being substantially $1 per ton. Independent records kept by Metcalf & Eddy and by the superintendent of the plant showed a nominal difference of only 2 per cent. in the cost.

Under efficient management the output of the crusher should have been 240 tons per day. The actual average during the three months' test was only half that amount, and this in the face of the fact that the men were the best that could be found in the department. Although the perpetuation of the crusher plant hung in the balance and the work was under constant supervision, even these incentives lacked the power to offset personal inefficiency, lax discipline, short hours, high wages, half holidays and absence with pay.

The original conclusions of the Commission were emphatically confirmed, and the folly of undertaking to crush stone by day labor employed by the department was clearly demonstrated by the fact that the cost per ton was nearly double that for which it could have been produced by a contractor under similar conditions. Thus the knell was rung for a policy that in a dozen years had entailed a loss of a round million dollars."

* From an article by Walter B. Snow in the "American City."

ORDERS OF THE RAILWAY COMMISSIONERS OF CANADA.

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

8300 to 8302—October 8—Granting leave to the Consolidated Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. near Erin, Ont., and Hillsburg, Ont.

8303—October 8—Granting leave to the Manitoba Government Telephone system to erect, place, and maintain its wires across the track of the C.P.R. 1½ miles south of Altona Station, Man.

8304 to 8308—October 8—Granting leave to the Wroxeter Rural Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. in the Tps. of Howick and Turnberry, Province of Ontario.

8309 and 8310—October 8—Authorizing the Municipal Corporation of the town of Clinton, Ont., to lay water main under the track of the G.T.R. at Matilda Street, and where the same crosses Victoria Street to London Road in said town of Clinton, Ont.

8311 and 8312—October 8—Granting leave to Dr. F. J. Weidenhammer, of Hawkesville, Ont., to erect, place, and maintain, wires across the track of the C.P.R. just west and south-west of Wallenstein Station, Ont.

8313—October 13—Authorizing the C.N.Q.R. to reconstruct trestle approaches of its bridge over the St. Maurice River near Grand Mere, P.Q.

8314—October 12—Granting leave to the G.T.P. to construct its railway across certain highways in the district of West Saskatchewan, Prov. Sask.

8315—October 6—Granting leave to St. Maurice Valley Railway to cross with its tracks the tracks of the C.N.Q.R. at Grand Mere, P.Q.

8316—October 13—Approving and sanctioning location of the C.N.O.R. through the Tps. of Goulburn and Marlborough, County Carleton, Ont., mileage 17 to 29.

8317—October 13—Authorizing the C.N.O.R. to connect the lines and tracks of its Udney-Orillia line with the lines and tracks of the Georgian Bay & Seaboard Railway Company at Atherly Junction, Ont.

8318—October 13—Authorizing the Corporation of the City of Montreal, P.Q., to lay and thereafter maintain water main under the track of the C.N.Q.R., where the same crosses Nicolet Street, Montreal, P.Q.

8319—October 13—Authorizing the Corporation of the City of Montreal, P.Q., to lay and thereafter maintain water main under the tracks of the C.N.Q.R., where the same crosses Valois Street in said city.

8320 — October 12—Granting leave to the Consumers' Gas Company of Toronto, Ont., to lay and therafter maintain gas main under the tracks of the C.P.R. on St. Clair Avenue in said city.

8321—October 13—Granting leave to the C.N.Q.R. to erect, place, and maintain its tracks and telegraph wires under the wires of the Bell Telephone Company at Cap Rouge Station, County and Province of Quebec.

8322—October 12—Authorizing the Corporation of the City of Peterborough, Ont., to lay and thereafter maintain water main under the tracks of the C.P.R. so as to extend present main on Burnham Street to the premises of Peterborough Lumber Company in said city.

8323 to 8325—October 13—Granting leave to the Government, Province Saskatchewan, to cross the C.N.R. at one point and the C.P.R. at two points in the Province of Saskatchewan.

8326 to 8328—October 13—Granting leave to the Rural Municipality of Miniota, Province of Manitoba, to erect, place, and maintain its wires across the track of the C.N.R. at three different points in the said province.

8329—October 13—Granting leave to the Canadian Machine Tel. Co., Ltd. to erect, place, and maintain its wires across the track of the G.T.R. at Mount Vernon Station, Ont.

8330—October 13—Granting leave to the Manitoba Gov. Tel. system to erect, place and maintain its wires across the track of the C.N.R. Company at P.C. near Argue Station, Manitoba.

8331—October 12—Authorizing the town of Walkerville, Ont., to lay and thereafter maintain a sewer under the track of the Lake Erie & Detroit River Railway on Argyle Avenue in said city.

8332—October 13—Granting leave to the Manitoba and Saskatchewan Coal Company, Ltd., to erect, place, and maintain its wires across the track of the C.P.R. at Bienfait, Sask.

8333—October 11—Authorizing the G.T.R. to cross with its second track the track of the United Counties Railway at St. Hyacinthe Junction, P.Q.

8334—October 5—Directing that certain streets at St. Henri, in the City of Montreal, be protected by watchmen, to be appointed by the G.T.R.

8335—October 5—Granting leave to the C.N.O.R. to construct its line and tracks across the P.C. on Lot 26, Con. 1, Tp. Gloucester, County Carleton, Ont.

8336—October 5—Dismissing application of C.N.O.R. to connect its lines and tracks with the lines and tracks of the Manitoulin & North Shore Railway Company, in town of Sudbury, Ont.

8337—October 8—Rescinding Order of the Board No. 7343, dated June 23, 1909, by substituting for clause 2 of first part. Clause: "That on cheese shipped from points west of Montreal on separate rail bills of lading to Montreal, and which arrived at Montreal before the close of the season of St. Lawrence navigation then current, the railway companies absorb the Montreal wharfage and port warden's fees, provided the same cheese is exported from the port of Montreal not later than the 31st day of May of the following season of St. Lawrence navigation; the said absorption to continue xxx."

8338—October 15—Authorizing the G.T.R. to construct, maintain and operate certain branch lines in the City of Toronto, extending from a point in its Don yards, east of Trinity Street, across River Don and upon and along Cherry Street and certain other properties belonging to the City of Toronto, Ont., to and into the premises of the National Iron Works.

8339—October 14—Approving and sanctioning deviation in location of portion of the Edmonton & Slave Lake Railway Company through Tps. 56 to 60, R. 25, west 4th Mer., mileage 21.39 to 46.68, Alta.

8340—October 14—Granting leave to the Commissioners of the Transcontinental Railway to carry its railway at grade, across its existing highway near mile 3, from the north abutment of the Quebec Bridge, County Levis, P.Q.

8341—October 14—Granting leave to the City of Calgary, Alta., to erect, place, and maintain its wires (used for operation of Calgary Electric Street Railway) across tracks of spur line of C.P.R. at 2nd Street East in said city.

8342—October 15—Approving and sanctioning location of the G.T.P. from mileage 229 to 289, Cariboo District, Province of British Columbia.

(Continued on Page 486.)

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

SEWER DISCONNECTING TRAPS.

An important sanitary question with reference to house drainage (bearing on sewerage) is receiving a great deal of attention at present, viz., the advisability (or otherwise) of trapping the house drain from the public sewer.

Ten years ago the question would have received an emphatic answer in the affirmative. To-day, however, there are scores of sanitarians, who hold that any trap placed on the line of the house drain is a useless and objectionable obstruction to the flow of sewage, as well as a means of cutting off a desirable method of sewer ventilation.

In trapping a private drain from the public sewer it is usual to fix a syphon trap on the line of drain at a point before it connects with the sewer. There are many varieties of this trap on the market, the trap being essentially a bend in the drain below the mean gradient. Sewage is retained in this bend, thus cutting off all air communication between drain and sewer. Above the bend, on the house side of the trap, an air pipe is connected with the drain. This supplies an inlet for fresh air, the outlet being (generally) the projection of the soil pipe to above the roof of the building.

The chief advantages claimed for this system of trapping are as follows:—

(a) Isolation from the public sewer, thus guarding against the transmission of disease germs from house to houe by means of the sewer gases.

(b) In case of plumbing defects in connection with sanitary fittings, the air drawn into the building will be fresh air fouled only to the extent of contact with the short length of house drain.

These claims are based upon the assumption that disease germs are transmitted in sewer air—an assumption, however, which appears to have no basis in fact, as clearly shown by the experiments recently made by Prof. Winslow, published in the issue of this Review of August 25th last.

Apart, however, from the truth, or otherwise, of the theory of sewer air transmission of pathogenic germs, the sewer trap appears to be an apology for defective plumbing, which in any case should not exist If we grant the transmission theory, then in the case of a single outbreak of typhoid in a house with defective plumbing, there is no reason why the house drains and down pipes should not be a means of distributing the germs to the whole household. In any case, it would appear important that all sanitary appliances should themselves be trapped and allow of no drain air connection to the building.

The argument, however, may be used: "After all, the sewer trap is an extra safeguard and can do no harm." This brings us to the crux of the whole question raised against the sewer traps. Does it do no harm?

Again granting the sewer air germ transmission theory and defective plumbing requiring a sewer trap, so as to minimize the dangerous character of foul air leaks, we must ask the question, What of the sewer air itself? The insertion of a sewer trap to every house drain means the confinement of the sewer air to the sewers. If the ordinary method of ventilation be adopted, viz., by means of open manhole gratings in the roadway surface, then these germ-laden gases will be eliminated, when they will be readily breathed in by the outside public. On the other hand, if airtight manhole covers be adopted, then it will be necessary to provide at great expense to the community sewer ventilation by means of special pipes carried from the sewers to points of safety.

Is it necessary to incur this extra expense of special sewer ventilation as an excuse for defective plumbing arrangements, or would it not be better, from all points of view, to insist that just as much attention be given to sanitary fittings as to gas fittings to ensure against leaks.

The removal of the sewer trap means that every house soil-pipe will tend to act as a sewer air outlet ventilator, and that the open street manhole covers will act as fresh air inlets to the sewer. Sewer air being as a rule warmer than outside air has a tendency to rise and pass off at the highest points, drawing upon the lower openings for equilibrium of supply.

Apart from the transmission theory of disease infection by sewer air, it is acknowledged that the gas products of decomposing sewage are objectionable. Emanations of foul odors from street gratings are common causes of public complaint in most towns, especially at high levels. It would, therefore, appear that where the cost of special sewer ventilation bars its adoption, the most efficient method is to be obtained by insisting upon:—

(a) Efficient and airtight plumbing and house drainage.

(b) That the local building authorities test all drainage and plumbing fittings by some test, such as the smoke test.

(c) The non-adoption of any trap between the house drain and the public sewer.

(d) The utilization of all soil-pipes and house drain ventilators as sewer air ventilators.

(e) The utilization of street manhole gratings as fresh air inlets.

(f) That all soil-pipes and drain ventilators terminate well above the eaves of buildings and away from windows.

SIZES, MATERIALS AND SHAPES OF SEWERS IN THE CITY OF HAMILTON.*

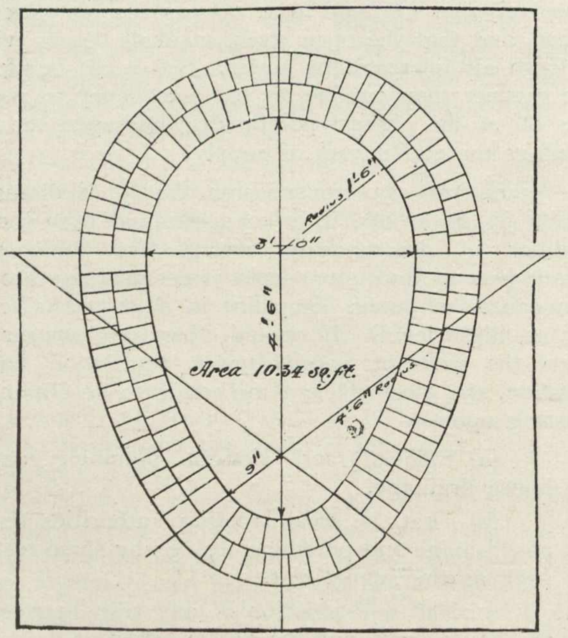
By E. G. Barrow, Hamilton, Ont.

It is at times interesting and profitable, especially for the municipal engineer, to take a peep backward into the early history of a city and carefully examine and consider the character of the engineering works constructed at the commencement of its existence, and then follow step by step the various changes in designs and materials which have taken place from time to time in accordance with the advancement made in engineering knowledge.

The object of this paper is not to give an account of the sewerage system of Hamilton, which would take more time than is at present at my disposal, but to describe the various forms and materials of sewers which have been introduced from time to time pointing out any defects which have been discovered, and stating also the cost of each particular class.

The first sewers built in Hamilton were commenced in the year 1852 and completed in 1857. They consisted of egg-shaped brick sewers, and were about 3½ miles in length. (At the present time there are 83 miles of sewers in Hamilton).

These brick sewers were mostly 4′ 6″ by 3′ 0″, as shown on the accompanying drawing. A small portion at the lower end was 5′ 6″ by 4′ 3″. The sewers on James and Catharine Streets were of the same size and area throughout their entire length, and of late years have become gorged at the lower parts and were totally inadequate to take storm waters. There is no record of how the size and area of these sewers was determined. The higher part is unnecessarily large and the lower part too small. They were built of brick with ordinary lime mortar. The top part, or crown of these sewers, as also the sides, are now in a good state of preservation, but the invert has been worn away and has had to be constantly repaired.



It is probable that the smooth surfaces now presented by cement walks and permanent roadways were not taken into consideration when the sewers were designed, and it is likely also that the higher parts were made large so as to admit of the passage of men through them.

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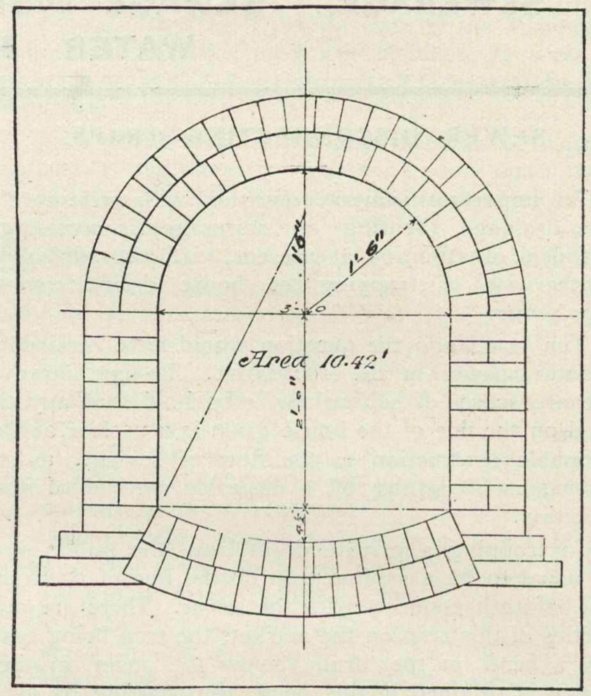
*Read before the Ontario Land Surveyors.

The advantage claimed for the oviform shaped sewer is its adaptability for varying flows; i.e., when there is only a small flow the invert of an egg-shaped sewer gives the necessary scour and keeps the sewers cleaner than a round or a wall-sided sewer. Evidently the wearing at the bottom of this class of sewer calls for a harder material than ordinary sewer brick.



It is really wonderful, however, how well the top and sides of these sewers are preserved, being now 60 years old. It has been necessary to relieve these sewers by overflow sewers, and still, during extraordinary rainfall, they are occasionally gorged. The cost of these sewers was $5.10 per foot, and their average depth 13 feet.

The next form of sewer was what is called the wall-sided, and was introduced into the system by Mr. Haskins, City Engineer. The first sewer of this class was built in 1889 and formed the trunk sewer for the west end district. The egg shape form was discarded because the ordinary flow was fairly uniform and copious, and the inequality of flow for which an egg-shaped sewer is particularly suitable was not present in this case, and by the adoption of the new form a cheaper sewer could be built and the wear of the invert on the egg-shape sewer avoided. This sewer cost $5.01 per foot, and was about 12 feet 6 inches deep. It is in a good state of preservation, and the invert is not worn to any appreciable extent. Water lime was the cementing material used.

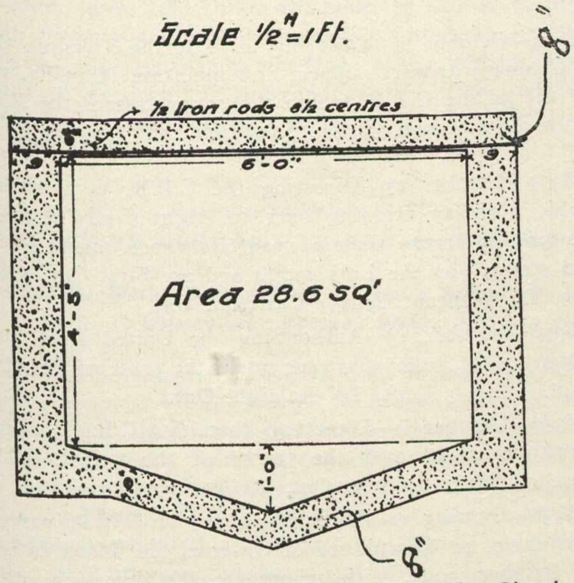
Vitrified pipe sewers were first laid in 1877, and the joints were made with clay. It was found that the roots of trees, especially the poplar, got into the seer through these joints and clogged them. There was also a large leakage of sewage at these parts. The above defects led to the introduction of cement joints in the year 1895.

No vitrified pipe sewer larger than 24 inches has been laid in this city, and many engineers consider 15 inches as the largest size they would recommend.

The first concrete sewer was built in 1905 on Sanford Avenue, and was circular in form and 3 feet in diameter. It was composed of one part of cement, 3 parts sand, and 5 parts gravel. The lower two-thirds of the sewer was built in moulds placed in the trench, and the remaining part was constructed above ground in two-foot lengths.

The cost of this sewer was as follows:—

	Cost per ft.
Labor moulding top 1-3 of sewer	$0.29
Labor moulding 2-3 sewer in place	0.98
Materials—	
Cement, 1.31 bags	0.655
Cost of centres and moulds	0.149
Gravel, 0.215 cubic yards	0.339
Tools and repairs of same, tow, nails, oil, etc	0.141
Lumber	0.195
	$2.759
Excavation 13 feet deep	2.765
Total cost per foot	$5.524



Cross Section of Concrete Sewer on Trolley Street.

This sewer, built in 1905, is the oldest we have of this material, and sufficient time has not elapsed to pronounce with certainty as to its superiority over brick.

The next concrete sewer was built in 1906 and was 3 feet 6 inches in diameter, circular in form, and constructed similarly to that last described on Sanford Avenue. A comparative cost of cement and brick sewers of same capacity is here given:—

Cement Sewer on Catharine Street, Wood Street to the Bay, Built in 1906.

3 ft. 6 in. diameter, 10 ft. 6 in. deep, and 1,465 ft. in length.

	Cost per ft.	Total cost.	
Excavation, labor 20c. per hour	$1 63	$2,389 61	
Cement work, moulds	1 19	1,745 60	
Cement, 2,091 bags at 50c.	71	1,045 50	2 06
Gravel and sand	16	233 75	
Lumber	09	137 48	
Repairing tools, rubber boots, nails, oil, etc.	06	82 13	
Advertising and inspection	11	164 30	
Engineering Department, levels, stationery	05	77 57	
Manhole	04	41 01	
1,465 ft.	$4 04	$5,917 04	

Note.—Cement concrete sewer, 3 feet 6 inches diameter, without excavation. Cost, $2.06 per foot.

Brick Sewer on Catharine Street, from Wood Street to Barton Street, Built in 1903.

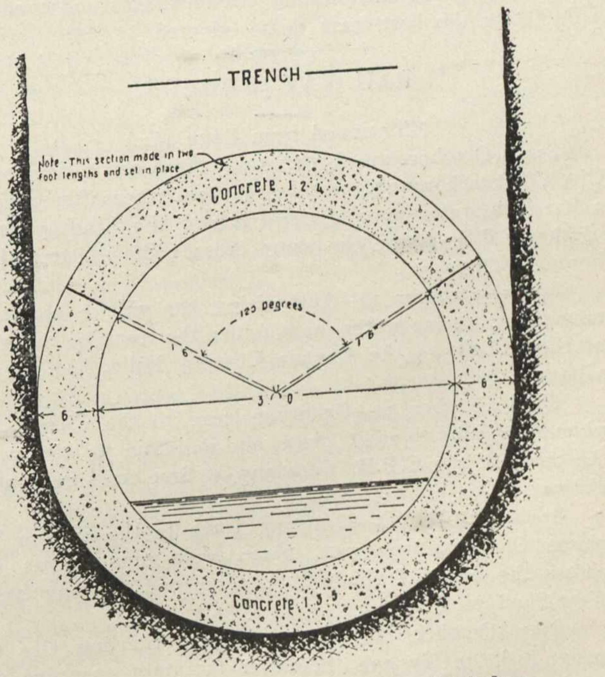
18 ft. deep and 2,933 ft. in length.

		Cost per ft.	Total cost.
Labor, excavating and filling, 18c. per hour		$3.908	$11,462 55
Labor, brick work, 35c. per hour		0.738	2,165 81
Brick, $6.90 per M.		0.895	2,625 93
Cement, 50c. per bag	2.205	0.468	1,374 55
Sand and gravel		0.104	306 15
Lumber		0.094	276 24
Dynamite		0.02	60 80
Tools, repairs		0.122	357 61
Iron pipe		0.13	383 82
Manhole castings		0.01	39 82
2,933 ft.		$6.489	$19,053 28

Brick sewer at current rates, same size, without excavation, would cost $2,757 per foot.

Cost of Above Sewer at Current Rates for Wages and Material.

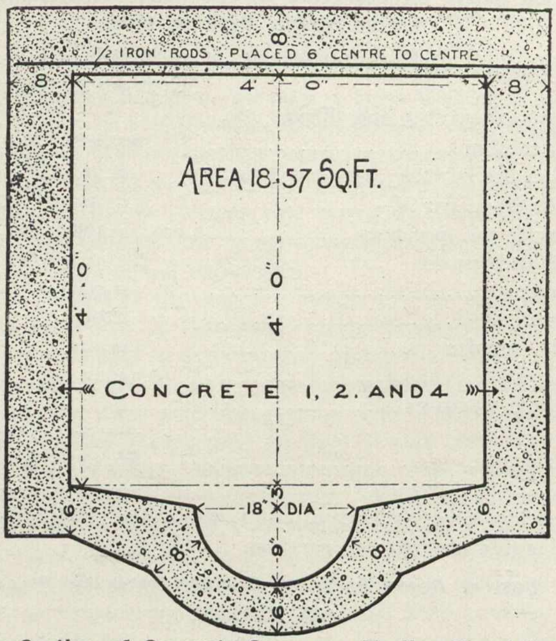
	Cost per ft.	
Labor, excavating and filling at 20c. per hour	$4.30	
Labor, brick work at 45c. per hour	0.95	
Brick at $9.50 per M.	1.235	2.757
Cement at 50c. per bag	0.468	
Sand and gravel	0.104	
	$7.057	



Cross Section of Concrete Sewer, Sanford Ave.

In 1907 a large reinforced concrete sewer was built composing the trunk sewer of an extensive district at the east end of the city.

For a large portion of its length this sewer had very little cover, and the following forms were designed to meet the existing conditions. The excavation was in very hard blue clay and could be excavated accurately to the shape of the sewer. The large section cost $10 a foot and the smaller one $7.85.



Cross Section of Concrete Sewer on Trolley Street from Barton Street to Beach Road.
Scale 1 in. = 1 Ft.

The relative merits of concrete and brick as a material for sewers is now being debated somewhat hotly. Our cement concrete sewers have not been down long enough to judge of their durability.

The experience in Hamilton would be that no cast iron rule can be laid down with regard to the shape of a sewer, but a study of the surrounding circumstances and conditions will dictate the best form to be adopted.

RAILWAY ORDERS.

(Continued from Page 482.)

8343—October 15—Authorizing the Corporation of the City of Peterborough, Ont., to lay and thereafter maintain a five-inch water main under track of the Lindsay Branch of the G.T.R. where the same crosses Park Street, Peterborough, Ont.

8344 — October 14—Authorizing the village of Georgetown, Ont., to lay water main under the track of the siding of the G.T.R. to the Canada Coating Mills, Ltd., in said village.

8345—October 14—Granting leave to the Citizen Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. Company at first crossing south of Bromo, P.Q.

8346—October 14—Granting leave to the Citizen Telephone Company to erect, place, and maintain its wires across the track of the C.P.R. at second crossing west of West Shefford, P.Q.

8347—October 14—Authorizing the Sterling Gas Company, Ltd., to lay and thereafter maintain gas pipe under track of the G.T.R. between Lots 20 and 21, Con. 1, Tp. of Humberstone, Ont.

8348—October 14—Authorizing the United Fuel Supply Company, Ltd., to lay and thereafter maintain a pipe for conveyance of natural gas under the track of the G.T.R. on Lot 8, Front Con. of Tp. of Raleigh, County Kent, Ont.

8349—October 14—Granting leave to the Bell Telephone Company to erect, place, and maintain its aerial wires across the track of the N. St. C. & T. Railway at P.C. corner Welland Avenue and Francis Street, St. Catharines, Ont.

8350—October 14—Granting leave to the Citizen Telephone Company to erect, place, and maintain its wires across track of the C.P.R. first crossing west of West Shefford, Province of P.Q.

8351—October 9—Authorizing the C.P.R. to construct branch line across and along Hardisty Street, City of Fort William, Ont.

8352—October 9—Authorizing the C.P.R. to cross with its tracks the track of the Port Arthur and Fort William Electric Street Railway at Syndicate Avenue and connect its tracks with the tracks of the Fort William Terminal Railway & Bridge Company, Fort William, Ont.

8353—October 14—Authorizing the City of Wetaskiwin, Alta., to lay water and sewerage pipes under track of the C.P.R. where the same crosses Pearce Street, Wetaskiwin, Alta.

8354—October 15—Granting leave to the Volcanic Oil & Gas Company to erect, place, and maintain its wires under the track of the C.P.R. where the same crosses the Walker Road at Lots 96 and 97, Tp. Sandwich East, County Essex. Ont.

8355—October 15—Directing the C.P.R. to construct a suitable highway crossing over its right-of-way where the same passes across certain road allowance marked "proposed street," on the Lots 23, 24 and 25, First Con. Ottawa Front, Tp. Nepean, County Carleton, Ont.

8356—October 15—Authorizing the United Fuel Supply Company, Ltd., to lay gas pipe under the track of the C.P.R. on Lot. No. 7, 3 Con., Tp. Raleigh, Ont.

8357—October 9—Directing that the C.P.R. maintain highway crossing over the tracks of the C.P.R. at East Street, village of Ignace, Ont.

8358—October 11—Directing that the C.N.R. carry out provisions of paragraph one of Order of the Board dated the 16th October, 1905, with respect to the diversion of Thibault Street, St. Boniface, Man.

8359—October 11—Ordering that the C.N.R. commence to construct subway at Pembina Street, Winnipeg, Man., on or before the first day of November, 1909.

8360—October 11—Dismissing application of the City of St. Boniface, Man., to carry Provencher Avenue across the tracks of the C.P.R. in said city.

8361—October 11—Authorizing the C.N.R. to open for traffic its line of railway from Benito, mile 18.8 to Pelly, mile 35.6, on its Thunder Hill Branch, Man.

8362—October 11—Dismissing complaint of F. C. Berry, of Austin, Man., against the G.T.P for alleged improper fencing of its railway.

8363—October 11—Dismissing application of the merchants, farmers, and residents of the district of Purves, Man., for Order directing the C.P.R. to erect a station and appoint an agent at Purves, Man.

8364—October 11—Dismissing complaint of Laing Brothers of Winnipeg, Man., that the C.N.R. charge excessive interswitching rate with C.P.R.

8365—October 19—Granting leave to the G.T.R. to connect its railway track west of Fielden Street, Port Colborne, Ont., with railway track or siding being constructed by the Department of Railways and Canals, to reach Government Elevator No. 2, Port Colborne, Ont.

8366—October 18—Authorizing the town of Yellow Grass, Sask., to lay water pipe under the tracks of the C.P.R. at Yellow Grass, Sask.

8367—October 18—Authorizing Messrs. St. Clair Bros., of Gault, Ont., to lay and thereafter maintain gas pipe under the track of the G.T.R. where the same crosses Beverley Street and Stone Road, Galt, Ont.

8368 to 8372—October 8—Authorizing the Volcanic Oil & Gas Company, Ltd., to lay and thereafter maintain pipe line under the tracks of the Michigan Central Railroad at four points in the Tp. of Essex and one point in the Tp. of Maidstone, Ont.

8373—October 19—Authorizing the United Fuel Company, Ltd., to lay and thereafter maintain pipe for conveyance of natural gas, under the tracks of the P.M.R.R. between Lots 15 and 16, first and second Cons. Tp. of Chatham, Ont.

8374—October 13 — Extending time within which the G.T.R. Company may appeal to the Supreme Court of Canada for leave to appeal from Order of the Board No. 7613, July 22nd, 1909; said Order directing the G.T.R. to provide station accommodation at or near the point where the railway company's line from Hamilton, Ont., to the town of Niagara Falls cross the town line between Tps. of Clinton and Louth, County Lincoln and Province Ontario.

(Continued on Page 498.)

SELECTIVE ECONOMY IN RAW MATERIALS.*

By Harry S. Mork, Engineering Chemist, Arthur D. Little Laboratory, Boston, Mass.

The keen, aggressive competition of modern business demands the most careful scrutiny of every element of manufacturing cost. In spite of this, observations extending over a number of years, under peculiarly favorable conditions, have sharply emphasized the fact that the economic selection of raw materials is not given the painstaking, systematic consideration which this vital detail of every industry deserves. It is no exaggeration to state that there is probably not one manufacturing concern in operation to-day for which a substantial saving cannot be made in the cost of at least one, if not several, of its raw materials, without the slightest detriment to the quality of its finished products.

Where a true selective economy is exercised in the purchase of raw materials, the choice is not determined by either quality or price, but by the relative industrial efficiency of the materials under consideration. The opportunity to economize may, therefore, lie in the substitution of a high-priced material for a cheap one; in a change from a coal which the fireman likes to one which gives more heat for a dollar; in selecting lubricants with reference to their physical constants instead of by brand; or, very commonly, in discarding altogether some particular material long in use in favor of another more efficient at the price.

Large industrial corporations provide and maintain purchasing departments, the duties of some of which apparently end when the necessary materials have been purchased from the customary source of supply, or at the best offered prices. To meet its full responsibility, and rise to its proper place in the organization which it serves, the purchasing department must have a much broader aim, and must search for and investigate every possible chance for economy which may have its origin in the source, properties and group relationships of available raw materials, no less than in their price. That so many purchasing departments voluntarily limit their scope and fail to grasp their opportunities, is explained by several reasons, of which the more important are:

First, lack of knowledge on the part of the purchasing agent of the fundamental chemical or physical qualities which make the material suitable. To be sure the majority of purchasing agents are not technically trained men, and cannot be expected to know many of these qualities. Consequently they cannot adequately appreciate what the market affords in materials with the suitable fundamental properties, especially when these are not obviously characteristic.

Second, ignorance of the group relationships of particular raw materials with other materials, which are thus overlooked, though equally available.

Third, lack of knowledge as to the source or origin of the specific materials offered. It is easy to pay too much for wood pulp under the name of filter masse, or for waste soda pulp liquor when buying boiler compound, or for type foundry waste when it appears as a special bearing metal.

Fourth, the tendency to adhere to the raw material, standarized years previously, because it has been demonstrated by long experience that it will do the work satisfactorily. While such an attitude does have its points of justification, far too often the case is one where great economies can be effected, but where the opportunity is unrecognized or lost.

Finally, and most important as the common underlying cause of all the others, the unwillingness to learn so often shown by those who should be broadest, but who are stubbornly and persistently narrow and intolerant of the views of others whose school may not be of such long experience, but rather of more varied training and more advanced thought.

Organized and co-operative effort is essential to the success of every large industrial concern. Without it there must be unnecessary losses. It certainly cannot be neglected in the selection of raw materials. For best economy there must be co-operation between the purchasing department and every consuming department, and especially should there be co-operation with the industrial chemist and chemical engineer, whose business it is to keep abreast of the rapidly-changing modern conditions of production, and who is in position to follow the course of a material from its first manipulation to its ultimate use, through many different processes and varied applications.

True it is that a material that is strictly raw when it is used unaltered in a manufacturing operation, but "raw material" may be defined broadly, and is here considered as any material the regular or periodic consumption of which is essential to the manufacture of a finished product. In the majority of instances the raw materials of one industry are the finished products of another, as, for example, wood pulp, bleach, alkali, flour, oils, glue, and paper.

In accepting the above conception of raw materials it becomes apparent that these may be derived from various sources. They may be obtained from natural resources or they may be the result of a manufacturing process, of which they may either be the primary product, a by-product or a waste. This last source is not by any means of slight consideration, and the history of the last few years has shown that live men are now awake to the great possibilities of large profits to be derived by successful utilization of wastes as raw materials in their own or other industries.

Raw materials may be classified in a number of groups, the factors to be considered in economical selection differing for these various groups. Such a classification may be made as follows:

* Presented at Annual Meeting of the American Chemical Society, New Haven, Conn.

First, materials which are simply refined.

Second, materials which become a component part of the finished product, undergoing varying degrees of alteration.

Third, where no part of the raw material appears in the finished product.

As simple examples of the class where the material is refined, we have raw sugar which goes through the various processes of solution, filtration, decolorization, crystallization, and granulation, in its conversion into granulated sugar; crude camphor, which has to be resublimed before it can be used in celluloid manufacture or as a drug; bauxite, or native alumina, which must be freed from iron and otherwise purified before it can be used in the electric furnace manufacture of aluminum, or in the production of the high-grade paper-maker's alum; crude argols from which is prepared cream of tartar.

In selecting materials of this class which shall be the most economical, much more than the mere price must be considered. The instances in which the lowest-priced material is actually the best are few in comparison with the many cases in which a higher-priced material is really the cheapest to purchase, because of its greater industrial efficiency. Moreover, if the goods are bought at the source of supply, differences in freight rates and losses in transportation influence decidedly the cost at the mill. The American cotton bale is so poorly put together that very few bales reach their destination intact, and the losses of cotton are sometimes so considerable that the evil is a subject of constant agitation. Cases are known where sections of railroads have practically been ballasted by the iron ore which has dropped from the cars. Liquids which are transported long distances in barrels or casks rarely net the same at their destination that they do at the point of shipment, and allowance must be made for leakage, the burden invariably falling on the consignee.

When the proper allowances have been made, and the cost of the material delivered at the refining plant is determined, the next factor to be considered is the percentage of refined product the raw material may be expected to yield. A chemical analysis will tell a great deal as to possible maximum yield; in other words, it will tell exactly how much of the desired ingredient is present, and will very probably tell how this is associated or combined with the other constituents. For these reasons an analysis is exceedingly important. It is, however, only a relative indicator of cost, as the nature of the impurities may be such that their removal can be effected only at a great expense, or be accomplished only by a considerable sacrifice of that portion of the raw material it is desired to preserve. Frequently it occurs that the valuable component of the raw material is so combined that its separation necessitates much more expensive processes than the separation of the same component from a material in which it is differently combined. In such cases, economy is determined not only by percentage composition, but by cost of separation. The mineral industry furnishes many examples of this nature. Many ores containing valuable metals in considerable amount are far more expensive to work than other ores of much lower assay. An iron ore analyzing high in iron, but also relatively high in phosporus, is more expensive to work than a lower grade ore with low phosphorus content.

The second class includes such materials as textile fibres, pigments, waxes, varnish, gums, wood pulp, oils and dyes; or, more specifically, raw cotton fibres are spun into yarns and woven into fabrics without the chemical composition of the original fibre being altered. Shellac is dissolved in alcohol to make a varnish, but it still remains shellac.

This class includes also materials which in becoming part of the finished product are chemically altered, like napthalene in the production of synthetic indigo; sulphur, or pyrites, in the manufacture of sulphuric acid; ores; cotton in the manufacture of soluble cotton; oils and alkali for the manufacture of soaps; and so on. When napthalene is converted into artificial indigo, it is first changed into phthalic acid, an entirely different chemical compound. When sulphur is converted into sulphuric acid, the first operation is to burn or oxidize the yellow sulphur with which every one is familiar into the colorless, stifling gas, sulphurous acid. In these two examples, the original substance is not only changed chemically, but also altered physically in a very marked manner. When, however, ordinary absorbent cotton is changed into highly explosive gun cotton, the cotton is converted into a different chemical compound, cellulose nitrate, but practically retains all the appearance of the original cotton.

As in the case of materials to be refined, location of the source of supply, freight, and transportation losses are important. It is also absolutely necessary that sufficient supply be available. It is no use to select one of several materials because it is the lowest priced, even if the other economy factors are equal, when the supply of the cheaper material may at any moment be cut off, especially when the margin of profit of the finished product is small, and the finished product is sold under a rigid contract.

The yield of finished product is obviously of prime importance. Directly associated with this is the quality and character of the waste. The value of a waste is in many instances just as vital a factor in determining the volume of profits as is the purchase price of the raw material itself. The price which can economically be paid for pyrites in the manufacture of sulphuric acid is often determined quite as much by the proportion of copper in the slag as by that of sulphur in the original material. Textile fibres offer an excellent example, for the short waste fibres from the pickers, and the card, and the combs, are a direct source of income to the mills. The conversion of blast furnace slag into cement affords another fine illustration, and the utilization of blast furnace gas for heat and power is now a very ordinary occurrence. The extraordinary statement has been made that in the not very distant future the blast furnace will be operated for the gas it produces, and that pig iron will be a by-product.

The opportunities for utilization of wastes are still many, and the conversion of a waste into a commodity means increased prosperity to the community. If all the flax waste straw lying valueless in the West were converted into half-stuff or pulp for paper, it would mean a great deal to the farmer and much to the paper-maker. If it were possible to utilize all the waste cellulose which grows each year and which is either burned or rots away, as the cotton stalks of the South, or the cane brakes of Louisiana, the problem of the preservation of our forests would be much simplified. Of lesser scope, but deserving of equal consideration, is a waste which is the direct result of some mechanical operation or of some chemcal process. To use such wastes adds to profits; not to use them may mean direct financial loss, for should the waste become a nuisance the way is paved for litigation and damage costs, or for the expense of relocation.

It may be of interest to indicate how a number of manufacturing wastes have been turned to profit. Sawdust can now be burned with facility under a boiler; its fuel value is about 40 per cent. of the average coal. Treated with alkali, it produces oxalic acid; and when pulverized it becomes useful as a substitute for ground cork in linoleum manufacture, or an absorbent for nitroglycerine in the production of dynamite. Tin plate scrap has for a number of years been a marketable product; the tin is removed from the sheet iron either chemically or electro-chemically, and both tin and iron find a ready market. The waste liquors from iron and copper pickling vats are now used as precipitants in the purification of potable waters. The waste wort from the modern malted breakfast food factories is fermented to vinegar. Gluten is made from starch factory wastes, lemon oil from the peel of culled lemons, wrapping paper from sulphite pulp screenings, and so on.

In selecting a raw material it is equally necessary to estimate how large an item of expense will be the labor and the power required to convert it into the market product. It not infrequently happens that the labor and power costs are in excess of the cost of the raw material. Consequently it is not economy to select the cheapest stuff to be found if it takes a disproportionate amount of labor to use it. In selecting a paint as a protective coating for either iron or wood, the cheapest paint will probably prove the most expensive when measured by the number of coats necessary to apply and frequency of renewal. There are, of course, cases where cheaper materials do sometimes require less labor in their conversion into the finished product. Lead in copper bronzes reduces the cost, and also makes them much more easily machined. A trolley wheel containing several per cent. of lead is much more easily turned than one without lead. As to the mileage such wheels will give is quite another question, and it is probably now generally conceded that high lead means short life.

The third class, in which no part of the raw material appears in the finished product, embraces substances of very diverse character and functions. It includes all materials which are catalytic in their action, like platinum. A catalyzer is a substance which by its mere presence increases the rate and efficiency of a chemical process without itself suffering any change. Closely allied are those materials which assist in the formation of the product, and are subsequently recovered, such as sulphuric acid in the manufacture of artificial essences and flavors. Here, the acid acts as a dehydrating agent, absorbing the water which is formed by the process, and ultimately becoming diluted to a point where it is no longer efficient. Quite different, but in the same broad class, are certain solvents such as acetone, alcohol, ether, etc., used in producing photographic films; or extraction solvents, such as naphtha in recovery of wool grease. In the first group the solvents, which are subsequently recovered, are used to alter the physical form of some other material; in the second group the solvent merely traverses the material and removes therefrom, without otherwise altering it, all substances soluble in the solvent. Some materials react on the basic raw material, and are themselves altered but subsequently recovered. This is illustrated very well by the ammonia used in the manufacture of carbonate of soda, by the ammonia soda process, and by the soda liquors of the soda pulp manufacture. They are also materials which produce an effect but are themselves destroyed, such as bleaching powder or the sawdust which is mixed with clay in forming porous terra cotta, and afterward burned away in the baking.

The most important materials in this class are those which never come in contact with the finished product during any stage of its manufacture, but which are absolutely essential to its production. Examples of such raw materials are found in lubricating oils and coal. This classification refers to coal used for power; gas coal and coal for coke fall more properly in the class where the material becomes part of the finished product with chemical alteration.

Coal is so universal a raw material, and coal economy so important and such a specialized subject, that an extract from a recent publication of this laboratory is well worth quoting. It says: "In buying steam coal the amount of heat that may be developed from it is the measure of its value to you. There is no by-product that may be utilized, except that in some cases the sale of ashes might be considered in this connection, but their removal is generally an additional expense. Two coals at the same price and containing the same number of heat units may not be equally desirable. The difference in volatile matter might cause the lower to prove more satisfactory under certain conditions of smoke restriction, while the higher volatile coal would probably be more applicable in a plant with fluctuating load. The amount and nature of ash in regard to the formation of clinker often needs to be considered.

"The liability of spontaneous combustion of one coal more than another, may make it advisable to pay several cents per ton more for one coal containing no more heat units than the other."

Referring to seven different coals, the analyses and results of evaporative tests of which are tabulated, this publication shows that of the seven neither the intrinsically best nor the lowest-priced coal would be the cheapest to buy.

As for lubricating oils, opportunities for economy can be found in most factories. In one of the largest corporations in the country, an expensive cylinder oil was being used on its machinery where a heavy machine oil would have answered equally well, with a saving of over $2,000 per year. There are many instances where equally efficient but cheaper oils can be substituted for more expensive ones; this is particularly true of cutting oils. But probably the greatest source of saving will be in the knowledge that one mill will be using the identical oils that the mill next door is using, but is only paying two-thirds the price for them.

Of the other materials of this class, which are no part of the finished product, economic selection is determined by the original cost, the relative power to do the work, the ease of recovery, the amount recoverable, and the effect on the apparatus and workmen. Carbon tetra-chloride is a solvent which is much more expensive than naphtha; it has anaesthetic properties similar to chloroform, consequently the workmen must be protected from its vapors; it also has slight corrosive action on iron containers; but it has the immense advantage of being non-inflammable, while naphtha is exceedingly combustible and forms highly explosive mixtures with air. The property of non-inflammability reduces the fire risk and effects a saving in insurance. Insurance, although compensating for actual property destroyed, rarely makes allowance for loss of business during reconstruction.

Looking at raw materials broadly and without classification, there are a number of points of special interest. As stated before, the cases in which the lowest-priced material is actually the cheapest are few in comparison with the number in which the higher-priced material is really most economical. Of the former, mention can be made of synthetic indigo, which is not only cheaper than natural indigo, but is also better. If the hopes of the indigo planters are realized, improved methods may enable them to reverse this condition. Sulphate of alumina is cheaper than crystal alum, and when valued on its alumina content is much more efficient; retort carbon at five cents is better as an electrode for aluminum manufacture than graphite at fifteen to seventeen cents; ultramarine is cheaper and better than smalts. In the latter case, in which higher-priced materials are most economical, mention can be made of carborundum, which costs more than emery, but has far greater efficiency. A cheap babbitt metal is more expensive than a higher-priced one, if its intrinsic value is commensurate with its price. Steel trolley wheels have a cheaper first cost than bronze wheels and give a longer mileage, but serious wear on the trolley wire, and the high loss of power through resistance, probably more than compensates for the difference in first cost. Copper generally, but not always, has a higher industrial efficiency as an electrical conductor than iron. Under some conditions of price and service aluminum should be preferred to either. Carloads of sal soda have been used because it costs less than soda ash, and because of ignorance of the fact that it is only three-eighths as strong. The balance is just water, what is known as water of crystallization, which in itself never makes crystals appear moist or wet, and which, therefore, is not obviously present.

This example introduces another element of consideration. Every manufacturer realizes that water costs something, but it does not cost as much as soda ash, or as much as paint, or as much as the sizing dissolved in it. Dry materials are better because they are really cheaper, because the freight bill will not be so large, because they are more uniform, and because you know what you are actually paying for. If it is necessary that water be present, the purchaser can himself add it to better advantage.

There are many instances where cheaper materials have been substituted for more expensive ones without decrease of efficiency, and the field for economic substitution is still very large. Casein has taken the place of glue in paper coating, celluloid the place of hard rubber, and kerosene the place of whale oil. In the other hand, the composition or quality of the finished product frequently determines the selection of a raw material. For a very white, high-grade paper a hydrate alum, practically free from iron, must be used; for a lower grade paper a bauxite alum will answer to every extent as well. Ground wood papers have their field in ephemeral publications, but have no place where permanency is essential. Caustic soda will make good, hard soap, but the more expensive potash is required for soft soap.

It is to be regretted that it should ever happen that opportunities for economy are lost, because some one in the organization sacrifices his integrity and loyalty to personal gain. The textile chemical dealers probably have to meet this unfortunate condition more frequently than almost any others, but they are by no means alone. It is difficult to say, where such conditions exist, who is the more to blame, the salesman who, to push his goods, makes presents or allows secret commissions to the purchaser's employees, or the dyer or engineer or pressman who allows himself to be so easily corrupted. All are doing just so much to undermine the industrial efficiency upon which the welfare of the whole community depends.

The highest possible industrial efficiency, measured finally, as it must be, in terms of dollars and cents, although involving many other factors and leading to greater and better ends, is in the last analysis the test and object of selective economy in raw materials. It is the duty, as it is becoming in large measure the privilege, of the industrial and engineering chemist to raise the standard and increase the output of productive effort, and in no way does he do this more effectively than by enabling the manufacturer or the purchasing agent of a public service corporation to properly evaluate and control the quality of his supplies, helping him in the selection of the most efficient, and, therefore, the most profitable of available materials, and insuring to him by chemical control that the selected material is, in fact, delivered and held to quality in every shipment.

RAIL GROOVES AND TRACK GAGE FOR CURVED TRACKS.*

By C. W. L. Filkins, M.C.E.

The primary principle of wheel contact on curves is that the forward inside wheel of a car truck shall bear against the inside guard and the rear outside wheel against the outside guard, thus keeping the flanges of all of the wheels clear of either rail head and eliminating the side-wear on the heads. In practice this is impossible, due to irregularities, and could not be maintained, due to the wearing of the guards. The ideal conditions would be new wheel flanges and a particular rail for every curve, wheel-base and flange, but this is prohibitive, both for the traction company and the manufacturer, owing to inaccuracies in wheel setting, different flanges and wheel-bases over the same track, and most particularly to the necessarily limited number of types of rolled guard rail sections.

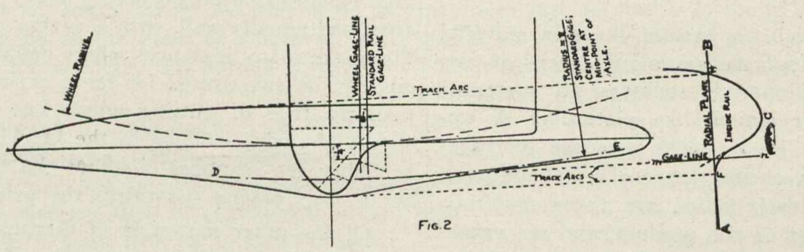


Fig. 2

Determination of Minimum Groove.

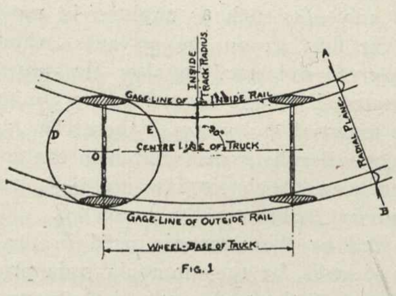


Fig. 1

Having a fixed rail groove as above intimated, it is desired to know if that groove will properly serve under the given conditions, and if not, how to alter it to meet them. Without discussing the question of wear on wheels or rails, as others have somewhat thoroughly considered that in the forms of wheel flange and rail groove, let us find the mini-

*Paper presented as a part of the report of the Committee on Way Matters.

mum groove in which a given wheel flange will run, on the assumption that the equipment is geometrically perfect. In a car traversing a curve, the longitudinal axis of the car truck is normal to the radius of curvature of the track drawn to the mid-point of the truck, the wheels being held rigidly parallel to the axis. The portions of the wheel flanges which determine the size and shape of the minimum groove are the portions below the shaded sections shown in Fig. 1. The shaded areas are sections of the wheels on a level with the wheel-tread. If we project these portions of the flanges upon a radial plane, we obtain the contours of the minimum grooves, as shown at AB. To obtain these projections (see ABC, Fig. 2), pass a series of planes perpendicular to the axis of the truck. They will cut lines from the surface of the flange. Project these lines by means of track arcs upon the radial plane AB (shown rotated about line AB, as an axis, into the plane of the paper). The outline curve FCH, tangent to all of these projections, is the contour of the required minimum groove.

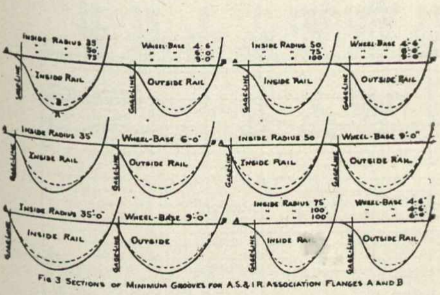


Fig. 3 Sections of Minimum Grooves for A.S. & I.R. Association Flanges A and B

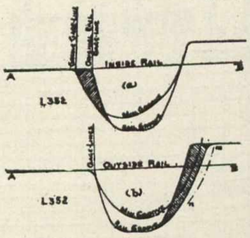


Fig. 4

The gage-line of a grooved rail or of a groove is customarily taken as the intersection of a horizontal plane through the tread-line with the head side of the groove produced, the rounded corner being ignored. Accepting this in what follows, we inquire the position of such a gage-line for the minimum groove as compared with a gage-line as determined by the standard gage. If in Fig. 1 with the mid-point O of the axle as centre, we describe the circle D-E, of diameter equal to standard gage and draw track arcs tangent to D-E,

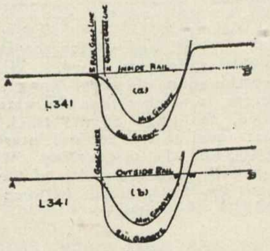


Fig. 5

Rail Grooves and Track Gage for Curved Track.— Figs. 1, 2, 3, 4, and 5.

one on each side, and produce then to A-B (Fig. 2), we determine the position of the standard gage-line. Only one such determination—at m-n—is shown in Fig. 2. For wheels set to a gage ¼-in. less than standard gage and with the wheel gage-line taken at a point on the fillet of the flange ¼-in. below the level of the tread, it is found that the standard gage-line and the minimum groove gage-line coincide for all flanges used at the present time. This also holds for M. C. B. flanges set to M. C. B. Association standard (M. C. B. Association Report of 1907). There may be a slight exception to the above conclusion in the case of American Street and Interurban Railway Engineering Association flanges A and B, for which the groove gage-line appears to fall outside the standard gage-line 1/32 in. for large wheel-bases and very short track radii. As other conditions will cover this item, we will ignore it in what follows.

By the method set forth above, the following set of minimum grooves has been obtained for the American Street & Interurban Railway Engineering Association flanges known as A & B (See Fig. 3.)

The dotted lines refer to flange B, the gage-line shown on these contours indicates the position of the standard gage-line, as explained above. In a similar manner, the minimum grooves for other flanges have been plotted, and the data so obtained used in Fig. 6, as will be explained later.

In what follows we premise that, owing to the uniformity of the wheel flange section, the practical inside groove required under given conditions is the same as the minimum groove for the same conditions; also that the inside guard guides the truck around the curve.

For equipment at the present time seems reasonable to limit the range of irregularities in wheel setting to ¼ or ⅛ in. to each wheel, distributed 1/16 in. on each side of the normal position of the wheel. Since this variation may occur simultaneously to double the effect, there is an ⅛-in. change outward and inward from the normal position of the outside wheel flange. The outward movement will seldom require attention, as it will probably be taken up by the fillet and riding on the head of the outside rail, and practice indicates that irregularities in that direction are rare. The inward movement of ⅛ in. must be provided for by holding the outside guard back, thus increasing the width of the outside minimum groove that amount for practical purposes.

Let us now adapt the minimum grooves of Fig. 3 to the following case: American Street and Interurban Railway Engineering Association flange A, Lorain Steel Company rail section No. 341, inside track radius of 50 ft., and wheel-base 4 ft. 6 in. Place the guard of L-341 tangent to the inside minimum groove contour for the given conditions—see Fig. 5 (a). The minimum groove lies wholly within the rail groove, and the rail gage-line fails to coincide with the standard gage-line by the amount M-N. Evidently the standard gage should be widened the amount M-N, and there is no planing of the rail section for the inside rail. Fit the head of the rail section into the outside minimum groove contour—Fig. 5 (b). The rail and standard gage-line coincide, and hence there is no widening of the gage due to this last operation. If V-W be not less than ⅛ in., the outside groove will be sufficiently wide to take care of irregularities. In general, if the width of the given rail groove exceeds that of the inside minimum groove, widen the standard gage the amount of the excess, the wheels being set as explained above. A further widening of the gage will but decrease V-W, and ultimately the wheels will bind between the guards, unless the outside groove were planed to greater width.

By width of groove is meant the horizontal distance between the guard and the gage side of the groove measured on a level with the tread, the rounded corner due to fillet or head being ignored. By plotting the widths of the minimum grooves as abscissae and the wheel-bases as ordinates, it is found that for a given flange the width of the groove varies directly as the wheel-base and inversely as a function of the track radius. Without insisting upon an accuracy closer than 1/32 in., the following simple formula for the width W (in inches) of the minimum grooves for the American Street and Interurban Railway Engineering Association flanges A and B was obtained:

$$W = \frac{1}{16}\left(\frac{45\,B}{R} + 18\right)$$

where B = length of wheel-base in feet and R = radius of the curved rail in feet. Similarly for M. C. B. flange:

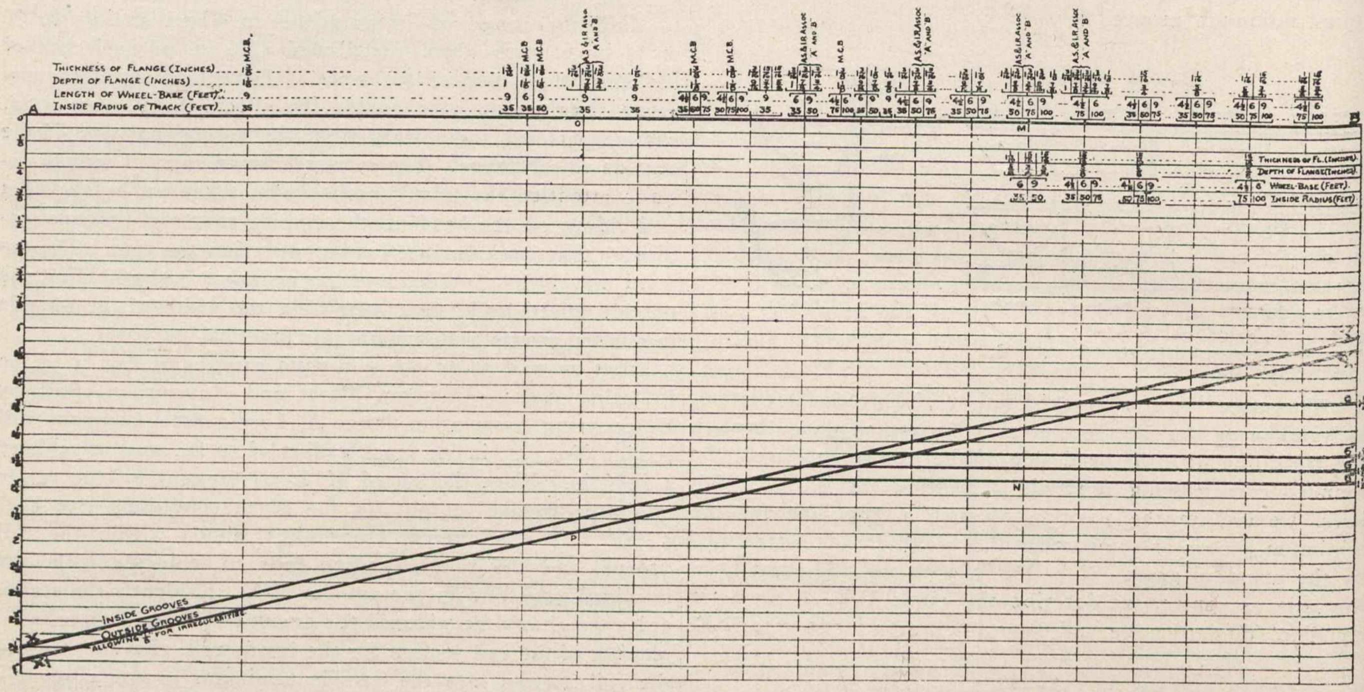
$$W = \frac{1}{16}\left(\frac{8{,}000\,(B-2)}{R^2 + 100\,R} + 24\right)$$

Six other flanges, whose groove widths have been used in Fig. 6, were determined in a similar manner, the formulae being similar in form to the first one given above. The formula for the American Street and Interurban Railway Engineering Association flanges does not give grooves wide enough by 1/16 in. or less for radii much in excess of 100 ft., but above 100 ft. the minimum groove differs inappreciably from the form and size of the flange section.

By means of the grooves which have been plotted, we are enabled to note the effects of variations in the given data as follows:—

(g) The effect of the gage is to make the width of the outside minimum grooves about 1/16 in. less than for the inside; hence the practical outside groove, allowing ⅛ in. for play, should be 1/16 in. greater in width than the inside minimum groove.

Using the inside minimum grooves as a basis (Fig. 6), draw a convenient oblique line X-Y as referred to a fixed base-line A-B. By means of the vertical scale, find points on X-Y at distances below A-B equal to the widths of these inside minimum grooves and draw the verticals to A-B, designating them as there shown. Results for a 7.5 ft. wheel-base have not been tabulated, but values for this wheel-base may be read off from Fig. 6 by direct interpolation. Thus, for a flange 1⅛ in. thick, ⅞ in. deep, and a 50-ft. inside track radius, the width of groove is 1 9/16 in. for a 9-ft. wheel-base and 1 7/16 in. for a 6-ft. wheel-base; hence 1½



The vertical distances between base-line AB and line XY represent the width of inside groove, measured on the level of the tread line of the rail, to pass the wheel flanges, in combination with the wheel-bases, on curves of the radii, all as given at the base-line AB. The vertical distance between line AB and line X_1 Y_1 represents the width of the groove of the outside rail which should be used in conjunction with that given for the inside rail, to allow for variations in wheel setting.

For wheels set to a gage ¼ in. less than the standard track gage and with the wheel gage-line taken at a point on the fillet of the flange ¼ in. below the level of the tread line, curves with grooves as in diagram should be laid to standard track gage.

Horizontal lines G, G′, G″, and G‴ represent the width of grooves in commercial girder guard rails now rolled. Where the width of groove necessary for the combination of wheel flanges, wheel-bases and radii, as given by the diagram, is smaller than the width of groove in the girder guard rail to be used, the gage of the track on the curve should be widened by an amount equal to the vertical intercept between the line XY and the lines G, G′, G″, and G‴ respectively. Where the width of the required grooves are greater than the width of the rail groove, the amount of planing is indicated by the intercept between XY and X_1 Y_1 and the lines G, G′, G″, and G‴ respectively.

Rail Grooves and Track Gage for Curved Track—Fig. 6—Width of Rail Grooves on Curves Under Varying Conditions.

(a) The width of the groove increases directly with and in the same amount as the width of the wheel flange.

(b) Increasing the depth of the wheel flange slowly increases the width of the groove, depending greatly upon the form of the flange in obtaining the increased depth.

(c) The effect of wheel radius upon the grooves is negligible for the present range of wheel radii.

(d) The effect upon the grooves of different track gages from 4 ft. 8½ in. to 5 ft. 4½ in. is inappreciable.

(e) The factors, outside of the wheel flange, which critically affect the grooves, are the length of the wheel-base and the track radius.

(f) For track radii greater than 100 ft., the minimum groove is practically the same as the flange section.

in. is the width of groove for a 7.5 ft. wheel-base, as would be given by the mean vertical.

Since the width of the practical outside groove must be 1/16 in. wider than that of the inside minimum groove, in Fig. 6 draw X_1-Y_1 1/16 in. below X-Y. The vertical lines between X Y and A-B give the necessary widths of inside grooves for the given conditions, as indicated at A-B, and similarly the necessary widths of the outside grooves, ⅛ in. being allowed for irregularities, are given between X_1-Y_1 and A-B.

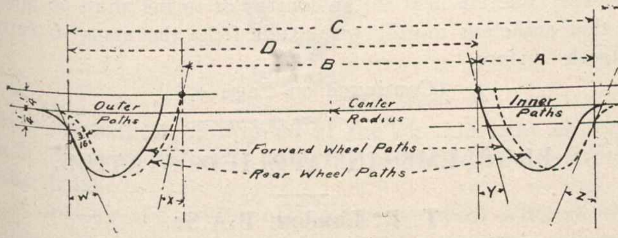
Theoretically the rail grooves should have the widths thus obtained, but we are limited by the commercial product in rolled sections, the widths of grooves of which are 1 5/16 in., 1 9/16 in., 1⅝ in., and 1 11/16 in, and a few specials.

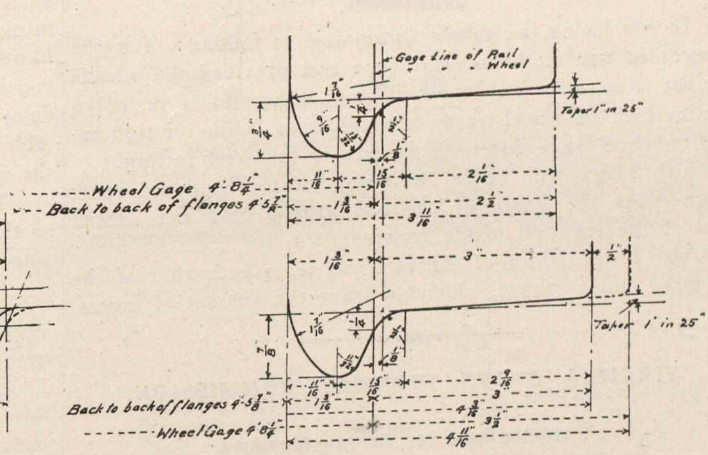
The widths of these grooves are shown in Fig. 6 by the horizontal lines G, G′, G″, and G‴. The effect of using some standard rail under given conditions, is now easily seen. For example, for American Street and Interurban Railway Engineering Association flange A, wheel-base 9 ft., inside radius 100 ft. and a 1 9/16-in. grooved rail; on line M-N on Fig. 6, we read the required width of inside groove = 1⅜ in. and of the outside groove = 1 7/16 in. Evidently the 1 9/16-in. groove of the given rail is 3/16 in. wider than the required inside groove and ⅛ in. wider than the required outside groove, as easily seen by the intercepts on M-N between G′ and X-Y or X_1-Y_1 respectively. Hence the gage must be widened 3/16 in., the intercept on M-N between X-Y and G′. We also note that there is a clearance of ⅛ in., the intercept on M-N between X_1-Y_1 and G′, between the outside flange and the outside guard over and above the allowance for irregularities. It might be well in this case to widen the gage an additional ⅛ in. and thus make greater allowance for irregularities and obtain earlier bearing against the inside guard.

1⅞ in. wide. The intercept on O-P between X-Y and a horizontal line corresponding to a 1⅞-in. groove is zero; hence there will be no widening of gage.

For the determination of the exact amount and contour of planing, place the guard of L-352 tangent to the inside minimum groove contour for the given conditions. See Fig. 4 (a). The shaded portion shows the amount of planing necessary to adapt this rail to the conditions. On planing this rail evidently its new gage-line will coincide with the standard and the minimum groove gage-lines, since the latter practically coincide, thus again showing that there wi'l be no change in the standard gage due to this operation.

Now fit the head of the rail section into the lines of the outside minimum groove for the given conditions. It is seen that the rail gage-line and the standard gage-line coincide; hence there will be no widening of the gage for these particular conditions, provided we do not allow for any irregularity in the setting of the wheels which would tend to increase the normal gage distance. That such irregularity





Cen Rad of Curve	4'6" Wheel Base								6'0" Wheel Base							
	A	B	C	D	W	X	Y	Z	A	B	C	D	W	X	Y	Z
35'0"	1 11/16	4'5 3/16	4'8 1/2	4'6 13/16	23°0	17°15	18°45	22°25	1 27/32	4'4 15/16	4'8 1/2	4'6 21/32	25°25	18°45	23°30	22°45
40'0"	1 5/8	4'5 9/32	4'8 1/2	4'6 7/8	24°30	14°55	16°30	24°20	1 3/4	4'5 1/16	4'8 1/2	4'6 3/4	24°00	15°40	20°30	22°15
45'0"	1 19/32	4'5 11/32	4'8 1/2	4'6 29/32	24°40	13°00	15°30	24°45	1 11/16	4'5 3/16	4'8 1/2	4'6 13/16	24°05	13°50	18°50	22°40
50'0"	1 9/16	4'5 3/8	4'8 1/2	4'6 15/16	25°40	11°10	14°40	24°20	1 21/32	4'5 1/4	4'8 1/2	4'6 27/32	24°55	12°55	17°10	24°30
60'0"	1 11/32	4'5 13/32	4'8 7/16	4'6 29/32	24°45	9°25	13°20	25°00	1 9/16	4'5 11/32	4'8 7/16	4'6 7/8	24°25	11°40	13°50	22°15
75'0"	1 1/2	4'5 15/32	4'8 7/16	4'6 15/16	24°55	8°25	11°25	25°00	1 17/32	4'5 13/32	4'8 7/16	4'6 29/32	24°45	9°35	10°45	24°10
100'0"	1 15/32	4'5 1/2	4'8 7/16	4'6 31/32	23°30	6°00	8°00	23°30	1 15/32	4'5 1/2	4'8 7/16	4'6 31/32	23°30	8°00	10°20	23°30
150'0"																
200'0"																
300'0"																
	Wheel Path Development Drawing No 51522								Wheel Path Development Drawing No 51512							

Cen Rad of Curve	7'6" Wheel Base								9'0" Wheel Base							
	A	B	C	D	W	X	Y	Z	A	B	C	D	W	X	Y	Z
35'0"	2 1/32	4'4 5/8	4'8 9/16	4'6 9/32	27°20	20°30	24°30	27°15	2 1/4	4'4 1/4	4'8 9/16	4'6 5/16	30°35	23°40	28°50	30°20
40'0"	1 15/16	4'4 13/16	4'8 9/16	4'6 5/8	25°15	19°40	23°10	25°00	2 1/16	4'4 9/16	4'8 9/16	4'6 1/2	27°35	21°30	25°30	27°40
45'0"	1 13/16	4'4 15/16	4'8 1/2	4'6 11/16	23°20	18°45	21°45	25°15	1 31/32	4'4 23/32	4'8 9/16	4'6 19/32	25°25	19°30	24°30	26°00
50'0"	1 3/4	4'5 7/16	4'8 1/2	4'6 3/4	24°50	17°20	19°25	24°10	1 7/8	4'4 7/8	4'8 9/16	4'6 11/16	23°35	18°50	19°55	25°30
60'0"	1 21/32	4'5 7/32	4'8 1/2	4'6 21/32	25°40	15°00	17°15	25°00	1 3/4	4'5 1/16	4'8 1/2	4'6 3/4	24°35	17°40	18°30	25°05
75'0"	1 9/16	4'5 11/32	4'8 7/16	4'6 7/8	25°00	11°45	15°05	24°25	1 5/8	4'5 1/4	4'8 1/2	4'6 7/8	24°15	13°40	15°35	24°15
100'0"	1 1/2	4'5 7/16	4'8 7/16	4'6 15/16	25°00	9°50	12°05	24°30	1 17/32	4'5 3/8	4'8 7/16	4'6 29/32	24°50	12°25	13°55	24°20
150'0"	1 7/16	4'5 9/16	4'8 7/16	4'7"	25°00	7°15	9°00	25°25	1 15/32	4'5 1/2	4'8 7/16	4'6 31/32	24°25	8°50	10°00	24°25
200'0"	1 13/32	4'5 5/8	4'8 7/16	4'7 1/32	23°30	5°40	7°00	25°30	1 7/16	4'5 9/16	4'8 7/16	4'7"	23°30	5°50	8°05	23°30
300'0"																
	Wheel Path Development Drawing No 51532								Wheel Path Development Drawing No 51542							

Way Matters—Tabulated Flange Path Data, Prepared by Pennsylvania Steel Company

With the same flange, wheel-base and same rail, let us try a 35-ft. radius. It is seen that the rail groove is 5/16 in. narrower than is required by the inside flange and ⅜ in. too narrow for the outside flange. The head of the inside rail must be planed 5/16 in. and the outside guard ⅜ in. The locations of these planings are so taken as to least affect the wearing portions of the rails, as shown in Fig. 4. Since planing a rail places it in a type with a wider groove, it must be placed in the wider groove class in examining for change from the standard track gage. The inside rail groove is now

Note.—The thickness of flange as used on this diagram (Fig. 6) is measured on a level with the wheel tread and is the distance from the guard side of the flange to the wheel gage-line, the latter being ⅛ in. inside of the standard track gage-line and at a point on the fillet ¼ in. below the wheel tread. The depth of flange is its extreme depth below the level of the wheel tread.

tends to decrease rather than increase the normal gage distance of the wheels is a practical fact.

From Fig. 4 (b) we see that planing of the guard is necessary, but due to irregularities in wheel setting, the total amount of planing is not immediately shown. Allowing for th's ⅛ in. in Fig. 4 (b), as shown by the dotted line, and drawing the fine full line to give a reasonable groove contour, the shaded area shows the amount of planing of the outer rail for practical conditions. To reduce the amount of planing from either rail, a slight shifting of the section along A-B, requiring a slight planing of the guard in Fig. 4 (a) or of the head in 4 (b), may sometimes be advisable. By increasing the amount of planing of the outside guard by ⅛ in., and widening the gauge ⅛ in., allowance may be made for an outward movement of the outside flange for irregularities, and an earlier bearing against the inside guard also obtained.

For uniform practice it is suggested that in the case of a widened gage the gage-line of the inside rail be made to conform to the geometrical position of the standard gage-line and the outside rail moved outward the amount the gage is to be widened. Geometrical purposes would thus require that the gage narrow abruptly at the points of tangency, even though not carried out in practice. Some of the usual methods of eliminating this widening in the neighborhood of tangents is to narrow the gage of the curve as it approaches the tangent; another is to carry the widened gage through onto the tangent and there gradually narrow down to the standard. As a matter of fact, the gage of the curved track contiguous to the tangent and the gage of the tangent should have an increased widening, as compared with the more central portion of the curve, as the straight track acts as a curve of increased radius in conjunction with the curve. This additional widening could be accomplished very effectively by giving a slight curve to an extension of the inside rail into the straight track, commonly called the straight guard on the end of curves.

Conclusions.

In conclusion, we might summarize as follows: For the flanges in use at the present time and provided the wheels are set ¼ in. less than standard gage at a point ¼ in. below the level of the wheel tread; also allowing ⅛ in. for tightening of wheel gage due to irregularities in wheel setting.

(a) There will be no widening of the standard track gage when the width of the rail groove does not exceed that of the required inside grooves;

(b) If the width of the rail groove exceeds that of the required inside groove, widen the gage the amount of excess.

VIRGINIA STATE HIGHWAY COMMISSION.

Specifications for Bridge Masonry.

Cement Rubble.

Rubble bridge and retaining wall masonry will consist of stones roughly squared, laid in irregular courses. The beds must be parallel, roughly dressed, and lie horizontally in the wall. Large flat stones shall be selected for the bottom. Each stone must be settled into place in full bed of mortar. The wall must be compactly laid, having at least one-fifth the surface of the back and face headers, so arranged as to interlock, having all spaces in the heart of the wall filled with suitable stones and spalls, thoroughly bedded in mortar. The face joints must not be more than 1 inch in thickness. The mortar shall be made of 1 part Portland cement, of a brand and quality approved by the State Highway Commissioner, and 2 parts clean, sharp sand, mixed in small quantities and at the time needed for immediate use.

If a stone becomes loose after the mortar has set, it must be relaid with fresh mortar.

The stones shall be hard and durable and at least six inches in the smallest dimension, and be free from seams or other imperfections, and in no case having a bed less than the rise.

The bridge seat and coping shall be built of selected smooth stones, well placed for the bearing plates.

For spans more than 150 feet in length the bridge seat and coping shall be made of concrete at least twelve inches in thickness.

Concrete.

The concrete shall be composed of broken stone or screened gravel and sand (all of which shall be clean, hard, sharp and free from clay, dirt and other objectionable material), and Portland cement of brand approved by the Engineer, and fresh clean water.

For plain concrete, to each part of Portland cement there shall be by volume 3 parts of sand and 6 parts of broken stone or screened gravel, and such proportion of water as the Engineer may from time to time determine.

For reinforced concrete to each part of Portland cement there shall be by volume two parts of sand and four parts of broken stone, and such proportion of water as the Engineer may from time to time determine.

The broken stones or gravel stones shall not be greater than 2 inches in diameter, and where concrete is less than 8 inches thick not over 1 inch in diameter. Broken stone shall be free of dust.

The cement and sand shall first be thoroughly mixed dry, in the proportions specified, on proper boards. Clean water shall then be added and the materials thoroughly mixed. The broken stone, previously drenched with water, shall then be deposited in this mixture and the ingredients thoroughly mingled and turned over until each stone is covered with mortar. The concrete shall not be allowed to fall from any considerable height, but shall be carefully deposited without delay and thoroughly rammed in layers not more than six (6) inches in depth until the water flushes to the surface and all the voids are filled.

The concrete next to the centres or forms shall be spaded so that sufficient mortar will exude from the mass to form a smooth surface.

(Continued on Page 498.)

PROBLEMS IN APPLIED STATICS.

T. R. Loudon, B.A.Sc.

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.

If the chain (Fig. 58) can safely stand tension to the extent of 1,500 pounds, what is the maximum weight that may be placed on the hook?

Let the chain be stressed in tension to its limit of 1,500 pounds. Choosing a point where the line of action of the force due to the weight intersects the centre line of the chain, practically, the condition at this point is such as indicated by the statical diagram (Fig. 61), the chain exerting a tensile force of 1,500 pounds at each side of the point, and the weight, of as yet unknown magnitude, acting vertically downward. These three forces are in equilibrium; therefore, their vector polygon, if constructed, must close.

If BC and CA (Fig. 62) be drawn to represent accurately the two tensile forces exerted by the chain, it is evident that the line joining A to B must represent the force exerted by the weight, for if BC and CA have been properly constructed, AB closes the diagram and represents a vertical force acting downward.

If a perpendicular be drawn from C (Fig. 62) to AB, it may be geometrically shown that—

$$AB = \frac{1,500}{2} \times \sqrt{3} + \frac{1,500}{2} \times \sqrt{3} = 1,500\sqrt{3} \text{ pounds.}$$

The maximum weight, then, that may be placed on the hook is 1,500 $\sqrt{3}$ pounds.

Let Fig. 63 represent diagrammatically a small cantilever bracket, the load which it supports being equiva-

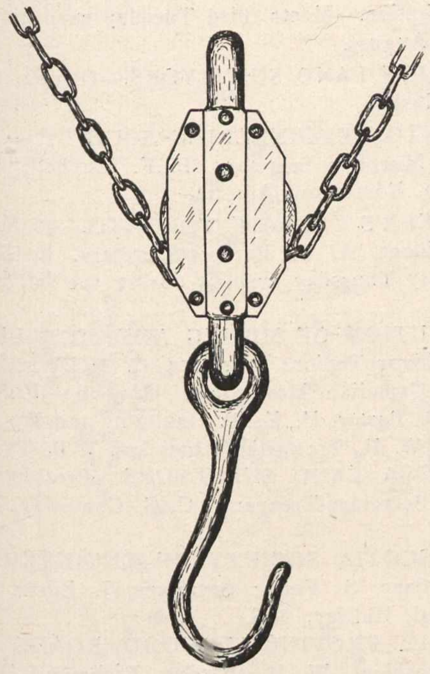


Fig. 58.

lent to 1,000 pounds applied at the outside joint as indicated. **It is required to find the stress in the members of the truss.**

Consider the forces acting at the point ABC of the frame. There is a known force BC of 1,000 pounds acting vertically downward, and two unknown forces, CA and AB, whose lines of action are known. The Statical Diagram (Fig. 64) represents this condition of affairs.

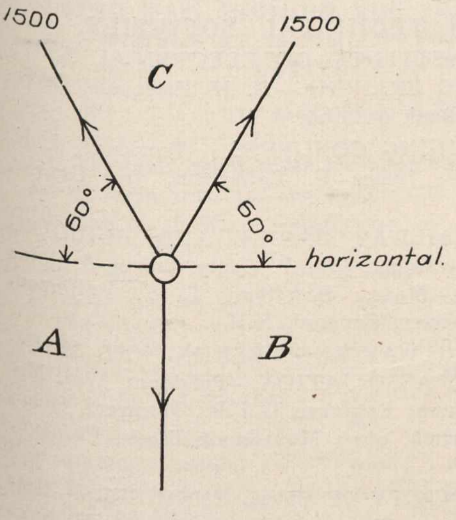


Fig. 61.

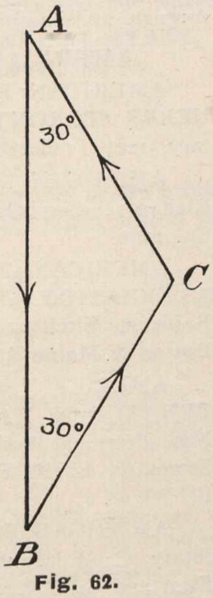


Fig. 62.

From any point B (Fig. 65) construct BC to represent the known vertical force BC.

Now, **since the forces under consideration are in equilibrium, their vector polygon must close.** Therefore, from C and B (Fig. 65) draw lines to represent the directions of the forces CA and AB, respectively. These lines intersect at A. Evidently, CA and AB (Fig. 65) represent the unknown forces CA and AB, the sense marks being continuous from the initial to the final point of the polygon as indicated.

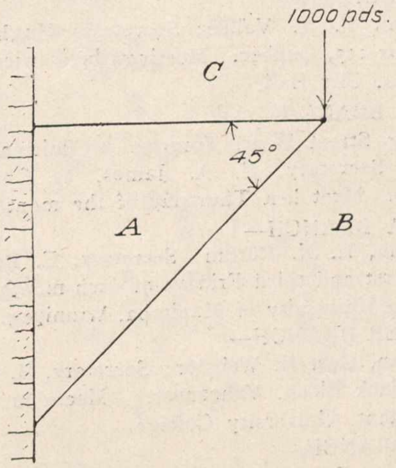


Fig. 63.

The triangle BCA (Fig. 65) is, from construction, a 45° right angled triangle; therefore, since BC represents 1,000 pounds, CA and AB represent forces of 1,000 pounds and 1,000 $\sqrt{2}$ pounds, respectively.

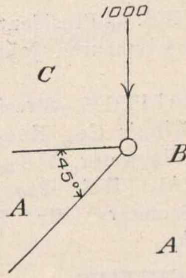


Fig. 64.

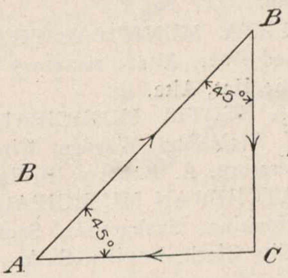


Fig. 65.

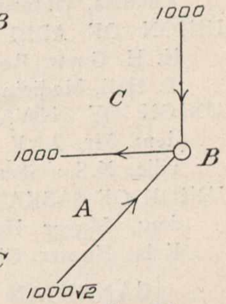


Fig. 66.

By drawing a new statical diagram (Fig. 66) and placing on it all the above deduced quantities, it is seen that the member CA exerts a tensile force and the member AB a compressive force at the point being considered.

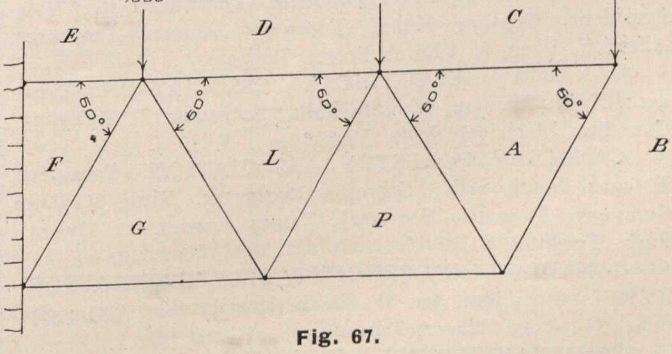


Fig. 67.

The member CA is, therefore, in tension (resists being torn apart) to the extent of 1,000 pounds, and the member AB in compression (resists being compressed) to the extent of 1,000 $\sqrt{2}$ pounds.

Find the stress in the members of a cantilever such as indicated in Fig. 67, the panels of which are equilateral triangles.

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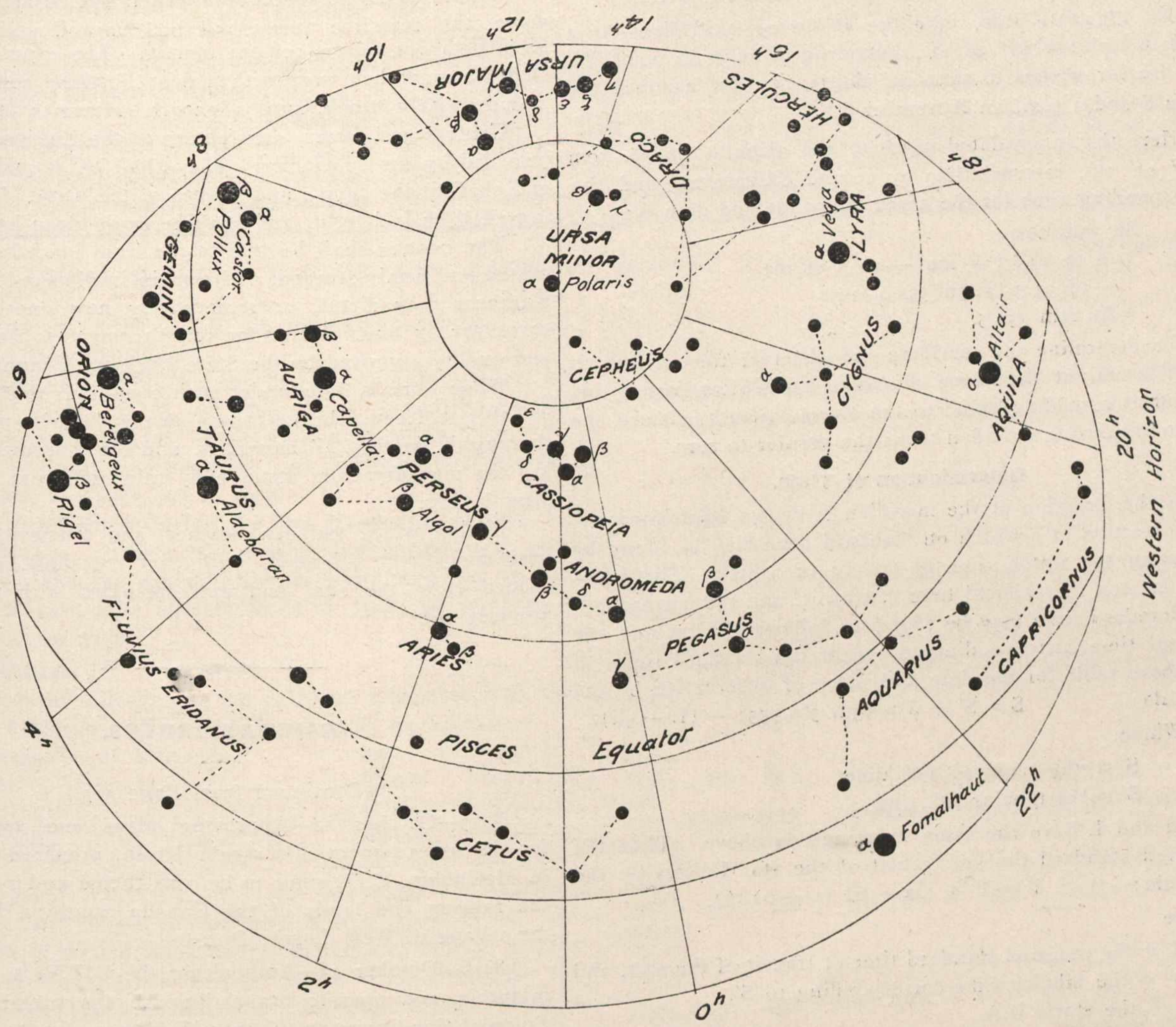
(Continued on page 50.)

ASTRONOMICAL PAGE



Star Map for November 1st, 1909, 10 p.m.

CUT HERE FOR REFERENCE.

STAR MAP, SHOWING THE PRINCIPAL STARS, VISIBLE AT 10 P.M., NOVEMBER 1st, IN LATITUDE 45° N.

L. B. Stewart, D.T.S.

The table below gives the apparent places of the brightest of these stars for November 15th at transit across the meridian of 5h W. of Greenwich.

Star	Mag.	R. A. h. m. s.	Decl. ° ′ ″
α Andromedœ	2.1	0 03 43.3	+ 28 35 40
β Cassiop..............	2 4	0 04 22.8	+ 58 39 19
α Cassiop..............	2.5	0 35 23.3	+ 56 02 44
γ Cassiop..............	2 3	0 51 16.0	+ 60 13 52
α Ursæ Min. (Polaris) ..	2.1	1 27 27.1	+ 88 49 37
α Arietis	2 2	2 02 05.4	+ 23 02 16
α Tauri (Aldebaran)....	1.1	4 30 45.0	+ 16 19 48
α Aurigæ (Capella)	0.2	5 10 11.9	+ 45 54 26
β Ursæ Maj.	2.4	10 56 23.0	+ 56 51 51
α Ursæ Maj.	2.0	10 58 08.8	+ 62 14 09
γ Ursæ Maj.	2.5	11 49 03.8	+ 54 11 41
δ Ursæ Maj.	3.4	12 10 56.2	+ 57 31 56
ε Ursæ Maj.	1.8	12 50 01.8	+ 56 26 53
ζ Ursæ Maj.	2.1	13 20 15 6	+ 55 23 44
η Ursæ Maj.	1.9	13 43 57.1	+ 49 45 46
α Lyræ (Vega)	0.1	18 33 51.3	+ 38 42 06
α Aquilœ (Altair)	0 9	19 46 21.5	+ 8 37 48
α Cygni................	1.3	20 38 20.2	+ 44 57 38
β Pegasi	2.4	22 59 23.6	+ 27 35 43
α Pegasi	2.6	23 00 15 6	+ 14 43 15

Determination of Azimuth by the Pole Star.

The following table gives the azimuth of Polaris on November 1st, 1909, for places in longitude 5th (= 75° W.) and at certain standard times T:

T	Sid. Time	Lat. = 44°		Lat. = 48°		Lat. = 52°	
		A	a	A	a	A	a
P.M. h. m.	h. m. s.	° ′ ″	″	° ′ ″	″	° ′ ″	″
8 00	22 42 39.8	1 05 24	—19	1 10 28	—21	1 16 47	—23
8 30	23 12 44.7	0 55 09	—21	0 59 2	—23	1 04 46	—25
9 00	23 42 49.6	0 43 54	—23	0 47 1	—25	0 51 35	—27
9 30	0 12 54.5	0 31 51	—24	0 34 20	—25	0 37 26	—28
0 00	0 42 59.5	0 19 14	—25	0 20 44	—27	0 22 36	—29
10 30	1 13 04.4	0 06 15	—26	0 06 45	—27	0 07 21	—30
11 00	1 43 09.3	359 53 10	—26	359 52 38	—27	359 51 58	—30
11 30	2 13 14.3	359 40 13	—25	359 38 40	—27	359 36 44	—29
12 00	2 43 19.2	359 27 36	—24	359 25 04	—26	359 21 55	—28

In this table azimuths are reckoned from the N. in the direction E.S.W. The quantity a is the error in the azimuth resulting from an error of 1m. in the time. It will serve to show the best time to observe if the watch correction is not well determined. The azimuth for any other latitude may readily be found by interpolation.

The standard time corresponding to any azimuth given in the table for a place whose longtitude differs from 5h, and for some other date, may be found by the formula:—

$$T' = T + (L - 5h)\ (1 - 0s.16) - d \times (3m\ 55s.9).$$

Where

T′ = the required time.

T = the time for November 1st.

L = the longitude.

D = number of days elapsed since November 1st.

The difference L — 5h must be algebraic, and in multiplying by 0s.16 it must be expressed in minutes of time.

To illustrate this, take the following example:—At a place in latitude 49° 20′ N., longitude 80° (= 5h 20m) W, an observer wishes to take an observation for azimuth between 8 and 9 p.m. on November 8th.

Here the interpolated value of the azimuth for 8h 30m is 1° 01′ 06″, interpolating by second differences, and the corresponding time for the given longitude and date is:—

8h 30m 00s
+ 19 56.8 (= 20m — 20 × 0s.16)
— 27 31.3 (= 3m 55s.9 × 7)
= 8h 22m 25s.5.

To determine the meridian the observer then points to the pole star at the above computed time, after setting his vernier at a reading equal to the above azimuth, clamps the horizontal circle, and then turns the vernier to zero.

Determination of Time.

If the direction of the meridian is known approximately, the correction of a watch on standard time may be found by observing the watch time of transit of a star. The star's R.A. is then the sidereal time of transit, and the corresponding standard time may be found as follows:—First find the sidereal time corresponding to one of the standard times of the above table for the date and place of observation by the formula: $S = S' + d \times (3m\ 56s.555) - (L - 5h)$.

Where

S = the required sid. time.

S′ = the tabular sid. time,

and d and L have the same meanings as above. Then the required standard time of transit of the star follows by the formula:— $T = T' + (\alpha - S)\ (1 - 0s.16)$.

Where

T = the required standard time of transit of the star, and

T′ = the tabular time corresponding to S′.

α = the star's R.A.

To illustrate the use of these formulae, let us assume that the meridian transit of the star α Pegasi is observed at the watch time 8h. 10m. 17.5 sec. at the same place and date as above; to find its correction on standard time.

		h.	m.	s.
Sidereal time, 8h. 10m. 17.5s. (table)	=	22	42	39.8
7 × (3m. 56s. 555)	=		27	35.9
		23	10	15.7
Difference of longitude	=		20	00
S	=	22	50	15.7
R.A. of star	=	23	00	15.6
α — S	=		9	59.9
10 × 0s.16	=			1.6
Equivalent mean time interval	=		9	58.3
T′	=	8	00	00
T	=	8	09	58.3
Watch	=	8	10	17.5
Watch fast	=			19.2

The methods described above do not take account of changes in the star places, but with ordinary field instruments and for short periods of time these are negligible.

VIRGINIA STATE HIGHWAY COMMISSION.

(Continued from Page 494.)

Should voids be discovered when the forms are taken down, the defective work shall be removed and the space filled with one to one cement mortar. The exposed surfaces shall be smoothed over with a neat Portland cement grout, laid on with a brush, until a smooth surface is secured.

Centres and forms, satisfactory to the Engineer, shall be provided by the contractor. They shall be of planed lumber and shall fit the curves and shapes of the work. The sheathing shall be laid tight, and shall be made clean before using.

The centres shall be true to the lines, satisfactorily supported and firmly secured, and remain in place as long as the Engineer may direct, or replaced by new ones if deemed necessary by him. Metal for reinforcement to be of section and quality approved by the State Highway Commissioner.

When work is done under such conditions that the mortar is liable to freeze, the necessary means shall be provided for thoroughly heating all materials, and for thoroughly protecting the masonry from damage by rain and frost during and after laying.

During warm and dry weather, and whenever the Engineer may direct, all newly built concrete shall be kept well shaded from the sun, and well sprinkled with water until properly set.

RAILWAY ORDERS.

(Continued from Page 487.)

8375—October 12—Approving plans and specifications for the improvement of Trigger Drain, prepared by George A. McCubbin, C.E., same to be constructed under and across the railway and lands of the Canada Southern Railway in the village of West Lorne, Ont.

8376—October 15—Authorizing the G.T.R. to construct, maintain and operate branch line to the premises of the Colonial Fur Company, County Middlesex, Ont.

8377—Ordering that the Corporation of the village of Thamesville, Ont., be made a party to the proceedings in re complaint of E. F. Best, of Thamesville, re dangerous condition of level crossings of G.T.R. and Wabash Railway Company in said village.

8378 — October 18 — Approving Standard Passenger Tariff C.R.C. No. 20 of the N.B. So. Railway Company.

8379—October 18—Approving character of work and construction of drain proposed by the Municipal Council of the Tp. of Harwich, County Kent, Ont., under the track of the Lake Erie and Detroit River Railway, now operated by the P.M.R.R.

8380—October 19—Granting leave to the Quebec, New Brunswick and Nova Scotia Railway to construct its railway across public road between parishes St. Foye and Lorette, County Quebec, P.Q.

8381—October 15—Granting leave to the C.P.R. to construct its spur to the waterfront in the town of Parry Sound, Ont.

8382—October 19—Granting leave to the C.P.R. to open for the carriage of traffic that portion of the double track of the Ontario & Quebec Railway, Smith's Falls Section, mileage 41.6 to 44.9.

8383—October 15—Granting leave to the C.P.R. to construct an extension of its railway across Arthur Street, village Elmira, Ont.

RAILWAY EARNINGS AND STOCK QUOTATIONS

NAME OF COMPANY	Mileage Operated	Capital in Thousands	Par Value	EARNINGS Week of Oct. 21 1909	EARNINGS Week of Oct. 21 1908	STOCK QUOTATIONS TORONTO Price Oct. 21 '08	TORONTO Price Oct. 14 '09	TORONTO Price Oct. 21 '09	TORONTO Sales Week End'd Oct. 21	MONTREAL Price Oct. 2 08	MONTREAL Price Oct. 14 '09	MONTREAL Price Oct. 21 '09	MONTREAL Sale Week End'd Oct. 21
Canadian Pacific Railway	8,920.6	$150,000	$100	$2,147,000	1.693.000	....	186¾ 185¾	183½	50	175¼ 175	186 185¾	183½ 183⅛	500
Canadian Northern Railway....	2,986.9	....	....	328.100	275,800	....	....	....	......	....	....	....	......
*Grand Trunk Railway	3,536	226,000	100	904,674	841,160	....	*1st. pref. 108½, 3rd pref. 57½, ordinary 23½					....	......
T. & N. O........................	334	(Gov. Road)	....	32.854	19,504	....	....	....	......	....	....	....	......
Montreal Street Railway	138.3	18,000	100	75,100	70.552	....	....	....	......	190 189½	212½ 210½	211½ 210½	987
Toronto Street Railway........	114	8,000	100	75,754	67,665	104½	124	124	291	104¾ 104⅜	125½ 124¼	125 123½	602
Winnipeg Electric..............	70	6,000	100	....	....	166	187¼	185	17	163⅜	....	....	......

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

GRAND TRUNK RAILWAY HALF-YEARLY REPORT.

The report of the G.T.R. for the half-year ending June, 1909, has been distributed.

The gross receipts for the first six months of 1909 are given as £2,866,468 8s. 7d. as against £2,854,787 for the first six months of 1908, some £12,000 of an increase.

The working expenses have also increased from £2,069,144 in 1908 to £2,079,196 in 1909.

The expenditure during the first six months of 1908 was 72.47 per cent. of the gross receipts and during 1909, 72.54 per cent. And the expenditure per train mile was in 1909 $1.10 per train mile against $1.05 in 1908, an increase of five cents per mile.

Train Mileage.

The train mileage for the half-year compares with that for the half-year ending 30th June, 1908, as follows:—

Description of Mileage.	1909.	1908.
Passenger	4,086,109	4,304,902
Freight	4,752,765	4,929,803
Mixed trains	240,528	226,051
Total	9,079,402	9,460,756

The total length of roadway is now 3,536 miles, with 709 miles of second track and 1,286 miles of siding, making a total of single track of 5,531 miles of all steel rails.

The cost per train mile for train, engine and cars is as follows:—

Half-year ended	Total Expenditure. Dollars.	Train. Mileage.	Rate of Expense per Mile. Train. Cents.	Engine. Cents.	Car. Cents.
June, 1909 ..	4,150,751	9,079,402	45.72	35.91	2.83
June, 1908 ..	4,337,989	9,460,756	45.85	35.65	2.94

	Passenger Trains.	Freight Trains.	Mixed Trains.
And the average number of cars moved per train was.........	4.5	26.7	6.8
And for the corresponding period.	4.3	25.8	6.6

The comparative cost of repairs per train, engine and car mile was:—

Cost per Mile.	Repairs and Renewals of Locomotives. 1909. Cents.	1908. Cents.	All Repairing Charges, including Shop, Machinery, Tools and Marine Equipment, etc. 1909. Cents.	1908. Cents.
Train	11.37	7.85	12.98	11.12
Engine	8.94	6.11	10.19	8.65
Car	0.70	0.50	0.80	0.71

The cost of repairs per car mile on the rolling stock was:—

Half-year ended	Cost per Mile. Car.	Train.
June, 1909	0.705	11.39
June, 1908	0.565	8.81

Expenses, Mileage, etc., in Motive Power Department.

Mileage.—000's omitted. Thus 731 = 731,000.

	Passenger Trains	Freight Trains	Mixed Trains	Total Train Miles	Switching, Piloting and Light Running	Total Train Miles	Company's Engineering and other Trains	TOTAL MILES
Total 1908..	4,304	4,929	226	9,460	2,708	12,169	305	12,474
Average for 6 mth's, 1908..	717	821	37	1,576	451	2,028	50	2,079
Average No. of Cars per Train..	4·3	25·9	6·6	15·6	..	..	..	..
Total 1909..	4,086	4,752	240	9,079	2,474	11,554	263	11,817
Average for 6 mth's. 1909..	681	792	40	1,513	412	1,925	43	1,969
Average No. of Cars per Train..	4·5	26·7	6·8	16·2	..	..	..	..

Expenses Per Mile in Cents.

	ENGINES, PER ENGINE MILE — WORKING EXPENSES: Locomotive Engineers, Firemen, etc.	Fuel	Water Supply	Oil and Sundries	Total Cost of Working	Repairing	Total Working and Repairing	Cars per Train Mile: Total Cost of maintaining Car Stock per Train Mile
1908	7.76	18.10	.62	.52	27.00	8.65	35.65	8.81
1909	7.90	16.74	.63	.45	25.72	10.19	35.91	11.39

The listed departments required the following per cent. of gross revenue:—

Maintenance of way and structures..................	9.50
Maintenance of equipment	8.25
Car department	7.42
Traffic expenses	3.18
Conducting transportation	39.60
General expenses	3.11

Altogether the report is satisfactory and encouraging, and now that the president of the Grand Trunk Railway system is to live in Canada—now that the head of this great system is to be near to the work, we expect coming reports to show even greater progress.

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.

New Brunswick.

FREDERICTON.—The city road committee is calling for tenders for 1,500 tons of the variety of trap rock which is taken from the Douglas and Kingsclear quarries.

Nova Scotia

HALIFAX.—Tenders will be received until Monday, November 1st, 1909, for the following fire hose:—3,000 ft. 2½ inch fire hose, 300 ft. 1 inch chemical hose, 10 ft. 4 inch suction hose, 20 ft. 2½ inch suction hose. All with couplings complete and suitable for Halifax Fire Department. L. Fred Monaghan, city clerk.

Quebec.

MONTREAL.—Tenders will be received up to Monday, November 1st, for boilers for the electric plant of the town of Verdun. Mr. Charles Brandeis, consulting engineer, 4 Phillips Place, Montreal.

MONTREAL.—Tenders will be received up to Wednesday, December 1st, on 1,000 h.p. water tube boilers, 200 lbs. pressure for The Saraguay Electric & Water Co. Mr. Chas. Brandeis, C.E., Montreal.

MONTREAL.—Tenders will be received up till noon on Tuesday, the 2nd November, for the supply and delivery of 12,000 tons of soft steam coal for the Low Level Pumping Station Point St. Charles. L. O. David, city clerk.

MONTREAL.—Tenders will be received up to Wednesday, 3rd November, for the construction of the undermentioned buildings and fences in the Corporation Yard at the south-east corner Huntley and Defleurimont Streets, viz.: 1. A dwelling house and stable; deposit required, $1,000. 2. An office building and storeroom; deposit required, $2,000. 3. A shop building; deposit required, $2,000. 4. A fence around the above yard; deposit required, $500. Plans and specifications may be seen at the office of Mr. R. L. Montbriand, architect, 230 St. Andre Street. L. O. David, city clerk.

Ontario.

KINGSTON.—Tenders will be received at the office of the Secretary, School of Mining, where plans and specifications may be seen, and at the office of the undersigned up to Saturday, November 10th, for the erection and completion of a Chemistry Building for the Governors of the School of Mining. Power & Son, architects.

LONDON.—Tenders will be received until Wednesday, November 10th, for underground conduit and cable system for electric light and power supply. Tenders are also invited until November 22nd on the transformers, motor generator set, voltage regulators, switchboards, lightning protectors, instruments, arc and incandescent street lighting systems, and other electrical apparatus. Address, Mr. E. I. Sifton, Electrical Engineer, City Hall.

OTTAWA.—Tenders will be received until Thursday, November 25th, for the packing of material and supplies for points along the Yukon Telegraph line between Quesnelle and Atlin, in the course of the season of 1910, 1911, and 1912. Forms of tender and specification may be obtained and form of contract seen on application to Mr. J. T. Phelan, Superintendent of Government Telegraphs, Vancouver, B.C.; Mr. William Henderson, District Superintendent Government Telegraphs, Victoria, B.C.; and from the Government Telegraph Agents at Ashcroft, B.C.; Quesnelle, B.C.; Hazelton, B.C.; and Telegraph Creek, B.C. Napoleon Tessier, secretary, Department of Public Works, Ottawa.

TORONTO.—Tenders will be received until November 2nd for the construction of a gate house to be built over the South Tunnel Shaft at the Island. Joseph Oliver (Mayor) Chairman, Board of Control. (Advertised in the Canadian Engineer.)

TORONTO.—Tenders will be received until Wednesday, 10th November, for all the cherry, birch, maple, spruce, hemlock and other classes of timber, estimated to contain over fifty million feet of hardwood, and over fifty million feet of soft wood, on a tract situated on the Georgian Bay at Beaverstone River. McCarthy, Osler, Hoskins & Harcourt, Toronto, Solicitors.

WESTON.—Tenders will be received until Monday, November 1st, for (a) laying 23,600 lineal feet of water mains, (c) steel water tower and foundation, (d) cast iron pipes and special castings, (e) fire hydrants, gate valves, valve boxes, etc., (l) sedimentation basin. R. J. Bull, Reeve; Willis Chipman, consulting engineer, 103 Bay Street, Toronto.

Manitoba.

BIRTLE.—Tenders will be received till November 1st, for the building of a Howe truss, 90 ft. span bridge over the Bird Tail, five miles southwest of Birtle, on cement piers now constructed. Plans and specifications at Public Works Department, Winnipeg, or at the Printing Office, Birtle. Bridge to be completed by January 1st, 1910. Write Wm. Lidster, Birtle, Man.

WINNIPEG.—Tenders for supply of sewer pipe and specials will be received up to Monday, November 1. M. Peterson, secretary, Board of Control.

WINNIPEG.—Tenders will be received up to Tuesday, 2nd November, for the erection of 5,000 lineal feet wire fencing required for Waterworks Park (McPhillips Street). Tenderers are requested to submit design and sample of fencing. J. H. Blackwood, secretary, Public Parks Board.

WINNIPEG.—Tenders will be received up to Monday, November 1st, for supply of one motor hose wagon for the Fire Department, capable of carrying 2,000 feet of 2½ in. cotton, rubber-lined fire hose, approximate weight 2,200 lbs., and six men, approximate weight 1,020 lbs. M. Peterson, secretary, Board of Control.

British Columbia.

VANCOUVER.—Tenders will be received until November 9th, for building a large bridge over False Creek, this city. Messrs. Waddell & Harrington, consulting engineers, Kansas City, Mo. (Details advertised in the Canadian Engineer.)

CONTRACTS AWARDED.

Ontario

LONDON.—For laying mains and supplying material, Mr. Chris. Leathorn has been awarded a contract by the Water Commissioners.

NEW LISKEARD.—The McKnight Construction Company have been awarded the contract for laying a sewer on Armstrong St. here, at $8,468.

FORT FRANCES.—Mr. W. W. Canaday has been awarded the contract for the electric light poles.

ST. THOMAS.—Messrs. Ingram & Davey have received the contract from Messrs. D. J. Wilson & Sons, architects, Chatham, for the metal work on the Grace Methodist church.

PETERBORO.—The Water Commissioners have decided to enter into a contract with the Wm. Hamilton Co., of this city, to supply a pump, waterwheel and travelling crane and to have the company remove the present pumps and install them in the new pump-house when advisable.

British Columbia.

VICTORIA.—The Hinton Electric Company of Victoria was awarded the contract for the installation of an improved system of fire alarms and call bells in the public schools.

VICTORIA.—Mr. J. H. B. Rickaby, who represents British manufacturers, will probably receive the contract for 87,500 feet of Mannesmann steel pipe, which is required for waterworks purposes. Mr. Rickaby's tender is $40,928. Leeming Brothers submitted two tenders, one for $52,536 and another for $41,557, while the Gardiner-Johnston Company, of Vancouver, tendered but did not state a definite figure. The tenders of the two latter were not according to specifications.

NEW WESTMINSTER.—Mr. W. W. Forester, of this city, has been awarded a contract by the British Columbia Electric Railway for the erection of repair shops 90 x 180.

NEW WESTMINSTER.—The contract for reflooring the roadway on the upper deck of the New Westminster Bridge here has been let by the Provincial Goevrnment to Messrs. Broley and Martin, of Fernie, B.C., at $22,000.

VANCOUVER.—At a recent meeting of the Board of Works tenders for a trunk sewer on Clark Drive were opened, the bids being as follows: M. P. Cotton, concrete and brick, $24,860; Palmer Bros. & Henning, concrete and brick, $16,500; Paterson Timber Company, concrete and brick, $19,922. For a series of tile-pipe sewers in the Cedar Cove section tenders were submitted as follows: George Hull, $25,450; A. H. Gordon, $23,900; Paterson Timber Company, $25,982. All the bids were referred to the engineer.

RAILWAYS—STEAM AND ELECTRIC.

Quebec.

MONTREAL.—The first cars for the new electric road, which is to connect Montreal with St. Lambert, across the St. Lawrence, by the Victoria bridge, have been received by the Montreal & Southern Counties Railway. The tracks and terminals are now nearly complete, and a trial run will be made shortly.

MONTREAL—It is announced by the Mackenzie & Mann interests that next spring they will start work on a new branch of the Quebec & Lake St. John Railway from Roberval running northwesterly to the recently-opened mining district of Chebougamou. The line will be pushed through during the summer to Chute a l'Ours, thirty miles northwest of Roberval. At this point there are very extensive water powers, which are owned by the Provincial Government.

QUEBEC.—The progress made upon the work of construction of the National Transcontinental Railway, in connection with the Quebec division, east and west, on both the south and north shores of the St. Lawrence during the past summer season, from April last, is remarkable. The track is laid from the Cap Rouge site of the Quebec bridge to the Charest River, with the exception of some small gaps aggregating four miles, which will be closed by the 15th of November. This is fifty miles from Quebec, and from this point 150 miles of the railway is in operation for construction purposes. From this point the track is being laid to the second crossing of the St. Maurice River, 188 miles from Quebec, and will be altogether completed by the 28th of December. The bridge over the second crossing of the St. Maurice will be constructed during the coming winter and open to traffic next spring, which will allow track-laying to proceed. The grading is now active for 25 miles west of Weymontachene, a Hudson's Bay post on the upper St. Maurice River, which is the point where the road runs west to strike the north end of Lake Abitibi, where the G. T. P. Construction Company have a contract for 200 miles of the road and are building both east and west of Lake Abitibi, making good progress. The construction work on the south shore is also making good progress, and the work all under way from Moncton to Levis. The track is laid in pieces all along the route, to enable the steamshovels to work. The steamshovels, engines, and cars used on the construction, are taken to pieces and forwarded over winter roads from 20 to 30 miles. The track has already been laid from the 13th mile from Levis to the 45th mile, a stretch of 32 continuous miles, and in addition a couple of miles from the Chaudiere have been tracked.

Ontario.

TRENTON.—A sub-contract has been let by the C.N.R. to Dibona and Orlando Bros. for the construction of the section between Trenton and Brighton, and they have brought their plant from Quebec to start work at once. They will begin at the Trenton end. A steel bridge with a swing span will be erected across the Trent river.

Manitoba.

BRANDON.—A new heating plant for the C. P. R. depot is to be installed at an estimated cost of $10,000.

BRANDON.—Extensions to the yards of the C. N. Railway at this point, are being planned.

WINNIPEG.—The first through train to Wetaskiwin over the new main line of the C. P. R. left for the west on October 26th. The regular schedule will not be commenced for a couple of months.

Alberta

EDMONTON.—Mr. George H. Webster, contractor for the first fifty miles of the Tofield to Calgary branch of the G. T. P., expects to have the grading completed as far as the Battle River and that the steel laying will probably be finished as far as the town of Camrose very soon. Mr. Webster said that his men began working about the first week in July and have been doing record work ever since. Between the Battle River and Tofield there is a mile of grading to be done into Tofield.

LETHBRIDGE.—The bridge over the Old Man River on the Lethbridge-MacLeod cut-off was completed ready for trains on October 22nd. Some riveting and ballasting is all that remains to be done. The line will be used some time next week.

EDMONTON.—On the Grand Trunk Pacific west of Edmonton, the construction gangs all the way along from the Pembina river to Tete Jaune Cache are working steadily, and at the rate at which the work is progressing the line will undoubtedly be graded and ready for steel by next fall. The bridge over the Pembina river is almost half completed, and will likely be finished by the end of November.

EDMONTON.—Under the name of the Pine Pass Railway, a company is seeking incorporation to build a railway from Edmonton through the northern wilds to Fort McGeorge, a Hudson's Bay post. The company is reported to have strong backing, financially, and as soon as the charter has been obtained construction will be commenced.

British Columbia.

NEW WESTMINSTER.—An interlocking switch which derails a train on the approaches if it goes against the signals, has arrived for instalation on New Westminster bridge.

KAMLOOPS.—The Canadian Northern will be in Kamloops within two years' time and will go down the Thompson and Fraser rivers to the coast. It is not definitely determined as yet whether the terminals will be located at New Westminster where the company has secured water frontage. The Grand Trunk Pacific will go south from Kamloops and on through the Nicola and Similkameen across the Hope Pass to the coast. The engineers who are now at work along Campbell Creek and in the Stump Lake and Nicola districts report splendid progress and it is understood that a survey will be carried as far as the Hope Pass this fall. The location of the Canadian Northern from Kamloops to Agassiz is now completed according to Superintendent White, who is in Kamloops. The line runs along the south side of the river. The Kettle Valley railway will be hooked up between Midway and Coutlee thus giving direct communication between the coast and Boundary.

PHŒNIX.—The C. P. R. is considering plans for the electrification of its line from Phœnix to the Granby Smelter. Power will be supplied by the West Kootenay Power and Light Company.

VANCOUVER.—The contract for the Lynn Creek line has been let to the Paterson Timber Company by the British Columbia Electric Railway. The equipment is already being assembled. Work will be commenced this week or next and will be then pushed forward as rapidly as possible. The line will be two and a half miles of single track and the Paterson Lumber Company will do all except put up the overhead work. The construction of the track will probably take from seventy to ninety days.

KAMLOOPS.—It is stated that the C. N. Railway intends to commence tracklaying operations from Kamloops, north, early next spring.

KAMLOOPS.—The C. P. R. is spending considerable money along the local divisions. At Spence's Bridge large coal chutes have been erected, and all the engines on the division between Kamloops and North Bend will be coaled there. A similar chute will be constructed at Kamloops to coal the engines from the eastern division. The outlay for these improvements will be about thirty thousand dollars. The remodelling and enlarging of the local yards is nearing completion—a work that will cost over fifty thousand dollars.

LIGHT, HEAT, AND POWER

Nova Scotia

DOMINION, C. B.—The civic corporation and the Sydney and Glace Bay Railway, Limited, have entered into a five years' agreement whereby the tram company is to deliver current at the rate of seven cents per kilowatt hour at the town line. The town has also arranged with the tramway and telephone companies for the privilege of stringing the transmission lines for their lighting system upon the poles of these companies. The civic body calculate upon the installation of at least 650 domestic and commercial lights and will install fifty 32 candle power incandescent street lights. The price of commercial and domestic supply has not been decided upon as yet.

Quebec.

MONTREAL.—The Fire & Light Committee recently made a report to the Council recommending that a contract be entered into with the Montreal Light, Heat & Power Company for the ensuing five years, from January 1st, 1910, at the following maximum rates: 1. Arc lamps per lamp, per year $75. 2. Inc. 65 c.p. lamps, per lamp per year $36. 3. Inc. 32 c.p. lamps, per lamp per year $24.

VERDUN.—The foundation for the new electric power station has been completed and the building is expected to be roofed inside five weeks. There will be no delay during winter months, the machinery being due to operate at the beginning of March.

Ontario.

PORT ARTHUR.—The contract entered into by the City Council with the Ontario Hydro-Electric Power Commission, for the delivery of power, will be submitted to the ratepayers for ratification by plebiscite on November 4.

Manitoba

BRANDON.—Rapid progress is being made here in connection with the installation of gas. Already 2,500 feet of mains have been laid.

SEWERAGE AND WATERWORKS.

Quebec

MONTREAL.—Mr. John R. Barlow, city surveyor, gives notice that sewers on a number of streets will be constructed immediately.

Manitoba

CARMAN.—A new waterworks system has just been completed here, under the supervision of Mr. W. E. Porter.

BRANDON.—The installation of two extra filters at the pumping station has been recommended by the city health officer, Dr. E. C. Beer.

Alberta

TABER.—A large force of men, under the direction of Engineer James Thorley, has been busily engaged the past two weeks laying the pipe which is to convey the water of the Belly river to Coal City. Now the pump at the river is in operation testing the strength of the mains preparatory to the filling-in of earth by Contractor R. A. Van Orman.

FINANCING PUBLIC WORKS.

Debentures were recently sold by the following municipalities:—

Peterborough, Ont.—$25,000 bridge on Smith Street.

Whytewold Beach, Man.—$1,500.

Summit Hill, Alta.—$1,500.

Kenora, Ont.—$26,770; schools and local improvements.

Pembroke, Ont.—$40,000, $10,000, electric pump and motor, $30.000, bonus Lee Manufacturing Company.

Kamloops, B.C.—$8,000 Hospital; $20,000 waterworks; $10,000 local improvements.

Ontario.

ST. THOMAS.—In January the ratepayers will be asked to sanction the expenditure of $10,000 on street railway improvements.

BLIND RIVER.—Debentures amounting to $12,000 are offered for sale by John Muncaster, clerk of the municipality.

BARRIE.—Until October 29 tenders are asked for $40,000, $20,000, $10,000 and $3,000 20-year, and $30,000 30-year debentures. Interest 4½ per cent. E. Donnell, town treasurer.

HAVELOCK.—A by-law will be submitted to the ratepayers of Havelock in January next to raise $8,000 for cement walks throughout the town, and $4,000 for a permanent drainage system.

NEW LISKEARD. — The town will probably borrow $10,000 or $20,000 for the construction of a road.

Manitoba.

BRANDON.—A by-law authorizing the sale of debentures to the amount of $13,000 was given a third reading and finally passed at a recent meeting of the council.

Saskatchewan.

KAMSACK.—This village is advertising for tenders for the purchase of $5,000 debentures.

MAPLE CREEK. — Sewerage debentures aggregating $45,000 are offered for sale until November 3rd by Mr. A. H. Greeley, secretary-treasurer.

MOOSE JAW.—School debentures amounting to $25,000 are offered for sale by J. W. Sifton, secretary of the town of Moose Jaw.

REGINA.—The following villages have been empowered to borrow money for permanent improvements:—

Melville, Sask.—$6,000; **Glen Ewen**, $1,000; **Watrous**, $15,000; **Wilkie**, $2,000; **Viscount**, $1,000; **Guernsey**, $1,500.

Alberta

NANTON.—This municipality has for sale $16,000 debentures. William Robertson, secretary-treasurer.

British Columbia.

REVELSTOKE.—The by-law to borrow $89,000 for the improvement of the power plant, was carried by the biggest majority that ever endorsed a by-law in Revelstoke.

NORTH VANCOUVER.—The ratepayers will vote on a by-law to borrow $128,000, for the construction of a first class steamer and wharves, at an early date, probably November 3rd.

VICTORIA.—The school trustees will ask the City Council to submit to the ratepayers a by-law to provide $150,000 for a new high school.

VANCOUVER.—A by-law providing $42,500 for park improvements may be voted on by the ratepayers in January. It includes $35,000 for rocking the roads, purchasing a roller and erecting a bridge.

VANCOUVER.—By an overwhelming majority, money by-laws aggregating $1,075,000 were passed last Saturday. One by-law is for $675,000, which is to cover the amount necessary to build a new bridge across False Creek at Bridge street, while the other is for $400,000 to meet waterworks expenditures.

TELEPHONY.

Manitoba.

WINNIPEG.—The C. P. R. has completed its telephone system from Cartier, Ont., to Brandon, Man., 1,045 miles.

United States of America

LOS ANGELES, CALIFORNIA.—Announcement was made here last week, that the telephone is to supplant the telegraph in train despatching over the entire Santa Fe system. Authority was granted for the equipment of the Albuquerque and Arizona divisions with telephones, and the work will be commenced at once. These two divisions total 887 miles.

CEMENT—CONCRETE.

Alberta.

BLAIRMORE.—W. J. Budd has returned to the Rocky Mountain cement plant and is rushing the work to completion. The overland light railway trestle-work has been completed by Mr. F. Knights, contractor, and the road is now ready for conveying rock to the crushers. The last piece of machinery has been put in and it is thought that cement will be produced by the 15th of November.

CURRENT NEWS.

Quebec.

MONTREAL.—A public competition is open between the architects, surveyors, engineers, draughtsmen, etc., of the city of Montreal for one or more schemes of improvements to St. Helen's Island, and the conversion thereof into a public amusement park. The cost of the work is not to exceed $150,000. Mr. L. O. David is the city clerk.

Ontario

BROCKVILLE.—The annual meeting of shareholders of the Brockville, Westport & Northwestern Railway Company, was held this week at the head office of the company here. Only formal business was transacted, such as the reception and adoption of the treasurer's report, election of the directors, etc. For the ensuing year the officers and directors will be as follows: President, E. R. Thomas, New York; vice-president and treasurer, Frederick T. Lewis, New York; secretary and manager, Carsten Heilshorn, New York; general superintendent, W. J. Curle, Brockville.

MISCELLANEOUS.

Quebec.

MONTREAL. — The Edgewater Company have purchased a large area of land near Ste. Anne de Bellevue, which is being sub-divided into lots. They propose to put in cement sidewalks, macadamized roads, sewerage, waterworks and electric light works and have appointed Mr. Chas. Brandeis, consulting engineer, to supervise the entire work. The improvements are estimated to cost $250,000.

Ontario.

KINGSTON.—Four properly constructed carts for the removal of garbage and other putrefying matter will probably be purchased by the Council at an early date.

Manitoba.

BRANDON.—Mr. Richard E. Speakman, city engineer, recently submitted to the Council estimates of the cost of a sub-way under the Great Northern and Canadian Pacific tracks at Eighteenth Street and of an overhead bridge for a sub-way, including concrete retaining walls and bridges, with a macadam roadway, 9 inches deep and a concrete sidewalk 5 feet wide at the side, the cost was estimated at $120,000. For an overhead, steel plate girder bridge, on steel towers with concrete bases, the bridge to be 30 feet wide, and a sidewalk on steel brackets to the side, five feet wide, with an approach to Pacific Avenue, the clearance to be 22 feet 6 inches above each railway, the floor to be concrete 6 inches thick, the estimated cost was $105,000.

British Columbia.

NEW WESTMINSTER. — City Engineer Blackman is preparing a report and plans for an incinerator which will likely be constructed early next year.

NEW WESTMINSTER.—The factory which J. C. McDonald, the successful tenderer for the steel pipe for the city's new water main to Coquitlam Lake, will erect, is to be in operation, it is expected, by the first of next year. A site for the plant has not yet been definitely settled on, but several are under consideration.

PERSONAL NOTES.

MR. W. M. STEWART has moved to 203 Garry Street, Winnipeg, from Vidir, Man.

MR. G. ARTHUR BENNETT, formerly of New Glasgow, is now with the Canada Iron Corporation, Fort William, Ont.

MR. OWEN W. SMITH, A. M. Can. Soc. C. E., of Galt & Smith, consulting engineers, Toronto, leaves this week for the West, on a business trip.

MR. HERBERT G. BERESFORD, of Dauphin, Man., has been granted a commission as a Manitoba land surveyor, according to the Gazette notices this week.

DR. J. A. AMYOT and DR. G. G. NASMITH, of the Provincial Board of Health, arrived in Lindsay, Ontario, on Wednesday, October 20th. They will inspect the ozone plant.

MR. R. G. McNEILLIE, chief clerk to General Passenger Agent McPherson, has been appointed district passenger agent of the C.P.R. in the Kootenays, with headquarters at Nelson.

DR. CHAS. A. HODGETTS, secretary of the Board of Health for Ontario, was elected first vice-president of the American Public Health Association, at the convention recently held in Richmond, Va.

MR. ARTHUR HEWITT succeeds Mr. W. H. Pearson, who has retired from the position of general manager of the Consumers' Gas Company, Toronto, after 55 years' service. Mr. Hewitt has already been with the Gas Company over 20 years.

MR. R. H. KNIGHT, B.A.Sc., of Driscoll & Knight, Dominion Land Surveyors, returned to Edmonton a few days ago after completing the survey of eight townships in the Onion Lake district, on the Saskatchewan side. Mr. Knight was away about four months.

MR. W. S. DREWRY, C.E., B.C.L.S., of Nelson, B.C., has been appointed chief water commissioner for the province, under the terms of the Water Act, passed last session, and assumes office immediately. Mr. Drewry was elected to associate membership in the Can. Society of Civil Engineers in June, 1887.

MR. W. S. CALVERT, M.P., for West Middlesex since 1896, has been appointed member of the National Transcontinental Railway Commission, to fill the vacancy caused by the death of Mr. Robert Reid. Mr. Calvert is 50 years old and was born in the Township of Warwick, in Lambton County. He was educated at the public school there, and later attended Watford Seminary. During the early part of his career Mr. Calvert was reeve of Metcalfe, and warden of Middlesex.

ENGINEERS' CLUB OF TORONTO.

The belief that the near future will see the earth circled in eighty hours by flying machines was expressed by Mr. J. R. d'Almeida before the Engineers' Club of Toronto last Thursday evening. Mr. d'Almeida has an idea of his own, and he believes he has the final solution of earial navigation. After the manner of a bird will his ideal machine fly. It will be self-righting, and will travel any distance without the least muscular effort by the mere extension of its wings. This will mean crossing the Atlantic in about twelve hours and circling the globe in less than eighty hours. Mr. A. B. Barry, president of the Club, occupied the chair.

MARKET CONDITIONS.

Montreal, October 28th, 1909.

The buying movement for iron in the United States continues in full force and surprises even those who have been looking for activity. The buying, however, is not uniform in all branches of trade, first one and then another branch being affected by it. Illustrating the heavy orders still coming in for semi-finished material, it is worth reporting that the average daily orders taken by the subsidiary companies of the United States Corporation during the first half of October amounted to about 84,000 tons. Some look for a period of dullness to follow, unless the railways give out good orders. These continue to be more of a factor than ever. Last week, the railway companies placed buying orders for 10,000 new steel cars and orders are now pending for 8,000 more, besides which, contracts for steel rails, aggregating 25,000 tons, have been given out. The structural steel business is also active, some 80,000 tons having been placed under contract this month, and some 100,000 tons being still under discussion. Plates and shapes and bars are firmly held and advances for next year's deliveries are taking place. The market for billets is also strong.

The English situation, while showing a moderate improvement, is yet without any decided tendency. Stocks of pig-iron continue to accumulate, but as the enquiry for shipment to American points is rapidly becoming more constant, it is hoped that sales will be arranged and stocks depleted by resulting shipments. The German and Belgian situation is showing improvement, and European conditions, generally, are looking better, but there is nothing like the upward tendency that is such a noticeable feature on this continent.

In Canada, conditions continue remarkably good. Not only is the volume of business showing a steady increase but prices continue to look upwards. Many foundry interests have covered for their supplies of raw material for the six months, but the trade, generally, is short of pig-iron. Those who have covered are now enquiring as to prices for delivery after the first of April next, and it is quite likely that heavy buying will be done on such deliveries within the next two or three weeks. Selling interests are, however, not at all anxious to make contracts for future deliveries, and are declining to submit figures for distant deliveries.

There is considerable activity going on in the market for finished and semi-finished products, but the changes in the market are slow in coming. Some lines have shown practically no change since the beginning of the present year and are not likely, now, to show any change until the close. On the whole, the market is firm, although some lines show a disposition towards easiness, there being special reasons for this, in each instance. The general hardware market is in excellent shape, there being a very encouraging demand from all quarters at the present moment. This demand will probably continue until the close of navigation.

Following is the list of prices:—

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

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.

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

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

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

Chain.—Prices are as follows:—¼-inch, $5.10; 5-16-inch, $3.95; ⅜-inch, $3.55; 7-16-inch, $3.35; ½-inch $3.20; 9-16-inch, $3.05; ⅝-inch, $2.95; ¾-inch, $2.90; ⅞-inch, $2.85; 1-inch, $2.85.

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

Copper.—Prices are strong at 14½ to 14¾c.

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. Double strength fuses, 4-ft., $3.75; 6-ft., $4.29; 8-ft., $4.83; 10-ft., $5.37. Fuses, time, double-tape, $6 per 1,000 feet; explohmeters, fuse and circuit, $7.50 each.

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

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

Iron.—The outlook is strong. The following prices are for carload quantities and over, free on dock, Montreal, prompt delivery; No. 1 Summerlee, $20.50 to $21; selected Summerlee, $20 to $20.50; soft Summerlee, $19.50 to $20; Clarence, $18.25 to $18.50; Midland or Hamilton pig is quoted at $20 to $20.50 per ton for No. 1 f.o.b., cars at point of production, No. 2 being $19.50 to $20, and No. 3 $19 to $19.50 for delivery during the next six months. It is said Dominion and Scotia companies are not quoting prompt delivery. Carron No. 1, $20.50 to $21; Carron special, $20 to $20.50.

Laths.—See Lumber, etc.

Lead.—Prices are about steady, at $3.50 to $3.60.

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.

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

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

Pipe.—Cast Iron.—The market is unsettled and uncertain, as dealers are compelled to meet competition from all sources. Prices are easy and approximately as follows:—$31 for 6 and 8-inch pipe and larger; $32 for 5-inch and 4-inch at the foundry. Pipe, specials, $3 per 100 pounds. Gas pipe is quoted at about $1 more than the above.

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

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

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

Railway Ties.—See lumber, etc.

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

Rope.—Prices are steady, at 9c. per lb. for sisal, and 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.

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

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

Telegraph Poles.—See lumber, etc.

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

Tin.—Prices are unchanged, at 33½ to 34c.

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

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Toronto, 28th October, 1909.

Founders and bridge-builders are well occupied, engine works, too, are busy. As a consequence the demand for both pig and structural iron has been brisk. Blast furnaces especially find the demand more than they can keep pace with. Coke has gone up, and if ore advances, as seems likely, there must be an advance in pig before long. In Britain the feeling in both iron and steel is upward, though price at present shows no marked advance. In the United States an increase in quotations has already been made.

Manufacturers and merchants are, as a rule, busy. A good fall trade follows, naturally, an unusually good harvest, and the retail trade begins to perceive the benefit. Dealers in brick and cement are still filling orders of more or less importance, while lumber dealers are busy enough to dispose them to maintain prices. Building, in the city, continues active.

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

Antimony.—Demand active and price higher at $9.25 per 100 lbs.

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

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

Boiler Plates.—¼-inch and heavier, $2.20. Boiler heads 25c. per 100 pounds advance on plate. 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 foot; 2-inch, $8.50; 2¼-inch, $10; 2½-inch, $10.60; 3-inch, $12.10; 3½-inch, $15; 4-inch, $18.50 to $19 per 100 feet.

Building Paper.—Plain, 30c. per roll; tarred, 40c. per roll. Demand is fairly active.

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

Broken Stone.—Lime stone, good hard, for roadways or concrete, f.o.b., Schaw station, C.P.R., 60c. per ton of 2,000 lbs., 1-inch, 2-inch, or larger, price all the same. The supply is excessive; hence the lowered price. Broken granite is selling at $3 per ton for good Oshawa.

Cement.—Manufacturers' prices for Portland cement are $1.35 without bags, or $1.65 including cotton bags for car lots on board car, Fort William or Port Arthur; the price at Toronto is $1.30 without bags, or $1.70 with bags. Smaller dealers get $1.35 to $1.40 per barrel without bags, in load lots, delivered in town. Demand is fairly steady.

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

Copper Ingot.—The market continues as before stated, price being $13.85 to $14.05, and the demand normal.

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

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

Roofing Felt.—An improvement in demand of late, no change in price, which is $1.80 per 100 lbs.

Fire Bricks.—English and Scotch, $30 to $35; American, $25 to $35 per 1,000. The demand is steadv.

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

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

Iron Pipe.—The expected advance has come; we now quote, 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, $16.39; 3-inch, $21.52; 3½-inch, $27.08; 4-inch, $30.76; 4½-inch, $38; 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.86; ⅜-inch, $3.08; ½-inch, $3.48; ¾-inch, $4.43; 1-inch, $6.35; 1¼-inch, $8.66; 1½-inch, $10.40; 2-inch, $13.86, per 100 feet.

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

Lime.—Retail price in city 35c. per 100 lbs. f.o.b., car; in large lots at kilns outside city 22c. per 100 lbs. f.o.b. car. Demand is good.

Lumber.—Prices continue steady, and city demand still active. 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,