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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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TORONTO, CANADA, JUNE 5th, 1908.

CONTENTS OF THIS ISSUE.

SEWAGE DISPOSAL.

On June 27th the ratepayers of Toronto will be asked to vote upon two by-laws, one involving $2,400,000 for a trunk sewer and sewage disposal works, and a second involving $750,000 for a water filtration plant. When the matter was first discussed there was a danger of several other schemes being voted on at the same time. Fortunately it is not so. It would be better if for the present the water filtration scheme were abandoned, and the question of the trunk sewer, and that only, were brought before the people.

The question that Toronto is face to face with is a live question in most inland towns and cities of Canada. For years they have poured their sewage into the rivers and lakes, sometimes contaminating their own water supply, in other cases polluting the water supply of other municipalities—in every case endangering the health of the people of the Province. Some years ago this method of pouring sewage into fresh water was not as objectionable as to-day. The urban population was not so dense, and the stream flow and water levels did not vary to such a degree. Many streams that ten years ago had a summer flow sufficient to dilute the emptied sewage are now, in summer months, a series of stagnant ponds and pools, breeders of disease germs. For years Toronto Bay has been a large cesspool, and Toronto's water supply has been a constant source of danger. The trunk sewer and sewage disposal works are a local necessity—a necessity that Toronto's citizens will recognize and supply the money for their construction.

But what about other towns and cities that are as unscientific and unhygienic as Toronto in matters of sewage disposal? It seems to us that Provincial Boards of Health should secure the services of an experienced sanitary engineer, who would act as consulting engineer for the municipalities; but he should do more: he should inspect the sewage disposal works throughout the country and recommend improvements where necessary. The Provincial Board should prevent the adoption of poor schemes and demand the betterment of many existing systems. Canada can ill afford to continue many of the existing sewage disposal plants. It would be good economy to improve and remodel them now.

EXPERT EVIDENCE.

Within a month in three Canadian cities there have been held three investigations. In each case the final decision is expected to be influenced by the evidence of expert engineers. Sane, conservative, practical advice is what is required; yet one cannot sit in the courtroom half an hour without concluding that the fate of the various propositions depends not upon their practibility, their reasonableness, or the justice of the claim, but upon the impression, artificial or otherwise, that the legal gentlemen are able to create by the use or abuse of the witness.

Expert witnesses have been used in the past, and will be in the future, to draw a herring across the trail. It has been suggested that expert evidence can be bought by the yard, or pound, or hour, as the occasion required. Perhaps this is one reason that great latitude is allowed counsel in cross examination. In direct examination the questions are usually simple, direct and logical. The witness gives information of value, as far as the opinion of one man is of value, one secures some ideas on the question under discussion. Then comes the coss-examination. The witness at once feels he must be guarded. Half-a-dozen skilled examiners and trained men are watching for an opening. His examiner plys questions at time direct and clear, again involved and confusing should the witness become confused; with a wave of the hand he is dismissed, or, perhaps, to add to his confusion a sarcastic remark is made at his expense and for his benefit. The result of all this is that the expert witness does not give expert evidence. In direct examination they do not tell as much as they would like to; in cross-examination they tell just as little as they are allowed. The court is not enlightened, but wearied.

When a court, or a commission, or a board of arbitrators require expert advice, they and no one else should select the witnesses, and they and not the interested parties should provide for their examination. The witness's standing as a professional man and a citizen would then add weight to his utterances; his evidence would be clear, concise and of some value.

EDITORIAL NOTES.

If you are planning a trip to Toronto in June, why not arrange to take in one or both of the Conventions? The American Foundrymen meet June 9th to 12th at Exhibition Park. The Canadian Electrical Association meet in the Engineering Building, Toronto University, June 17th to 19th. At both these gatherings there will be papers and discussions that will be of interest to you no matter in which branch of engineering you specialize?

* * * *

In our correspondence page this week there is a short description of a covered highway bridge. As an example of good engineering design suitable for to-day this bridge is of little value. Yet we are sure many will be interested in a wooden structure that has done service for sixty-eight years. Not only is it interesting because of its age, but because of its unusual design. We would be pleased to receive articles descriptive of old bridges, foundations, and large masonry culverts. A knowledge of the life of these structures is of value to you as an engineer. Give of your experience, and your fellow-practitioner will reciprocate.

NOTES ON THE ACTION OF WATER ON GALVANIZED IRON.*

W. F. Monfort.

"Notes" bearing this caption are usually concerned with the danger to the water consumer from zinc dissolved from the coating. The case here presented is considered primarily from a different standpoint; namely, the action of a partially softened water upon the zinc coating of galvanized iron pipes as affecting their durability.

A new meter with a galvanized iron cup, subjected to unusual service during 24 days registered 128,266 cubic feet, or 961,995 gallons. Upon removing the meter cup at the end of this period, it was found to contain a soft, adherent, yellowish-white coating. This was loosened by gentle rubbing with a rubber coated glass rod and rinsing, without abrading the harder underlying layer. The weight of the materials removed dried was 2.5 grams. Its analysis gave these results:

Zinc Oxide	75.7 per cent.
Carbon Dioxide	8.1
Ferric Oxide and Alumina	4.45
Calcium Oxide	trace
Magnesia	trace
Silica and Insoluble	11.31
	100.00

The cleaned surface showed a hard, brittle, black layer about 1/100 of an inch in thickness, rich in sulphides and in carbon, overlying the cast-iron body of the cup, with only traces here and there of the original zinc coating, which had been almost entirely removed or converted in place into zinc oxide and basic carbonate. No pitting or tuberculation of the iron had taken place, although one short rust streak occurred where the iron seemed freshly exposed, perhaps by a scratch made by the attendant who removed the cup.

The water which effected this change was fairly uniform during the period, as shown by frequent examinations, yielding the following average results:—

Bicarbonate alkalinity	21.9 parts per million.
Neutral carbonates	33.8
Total alkalinity	55.7
Total hardness	112.5
Calcium	20.
Magnesium	15.
Chlorine	18.
Sulphate ions (SO_4)	95.2

The absence of free carbon dioxide and the presence of considerable quantities of bicarbonate and neutral carbonates may be considered as the important factors in affecting the zinc, in connection with the abundant supply of dissolved oxygen which the water carried at temperature ranging from 42 to 52 degrees Fahrenheit.

The questions raised by the facts presented are:—

First.—The danger of contamination by zinc in solution.

Second.—The value of the zinc coating as a protection for iron pipes.

As to the first, it may be said that despite the rapid flow through the meter of almost a million gallons of water, so large a portion of the zinc compounds remained in place, that there is small chance of serious pollution from the slight quantity of basic carbonate or oxide which could dissolve.

Furthermore, repeated tests of this water after exposure to zinc, and its oxide and basic carbon for a period of an hour, show only infinitesimal traces of zinc.

As to the second point, the continuous action of an excess of this water through twenty-four days was sufficient to remove almost the entire body of zinc or to convert it into the compounds above-mentioned. While the coating left had sufficed thus far to prevent tuberculation of the iron, it could not be relied upon to continue this protective action indefinitely. It is true the amount of water passing the meter was equivalent to about twelve to fifteen years' supply for the ordinary consumer; but the short time (24 days) in which the action occurred points to a much shorter life of the zinc surface than fifteen years.

It may be that the underlying thin layer of sulphides and carbon would retard the further action of oxidation of iron for a time. But in these very impurities in contact with the iron lies an element of danger, in that there may develop differences of potential which would result in local couples. Unquestionably the pasty adherent zinc compounds may be considered more effective than the thin subjacent layer as a protective coating to the iron beneath. It must be remembered, however, that the total zinc in the 2.5 grams of compounds (= 1.5 grams zinc) remaining in the cup represents but a very small portion of the original body on the surface; since it is equivalent to a film of 0.003 centimeters in thickness, or 0.00118 inch over the surface of the cup. The larger part of the original zinc coating had been removed during its temporary solution in the formation of the compounds, or forming in

*Paper read before the American Waterworks Association.

place, these products had been eroded by the rapid stream of water.

That the residual coatings afford no permanent protection to the iron is evidenced by the tuberculation which occurs in galvanized pipe after long use in rapid flow. A section of an 1½-inch galvanized iron pipe which had been in use for an indefinite period is here shown. The tuberculation is quite well developed, and the pitting of the surface between tubercles shows how completely the protection has failed.

The distribution of these tubercles suggests the action at some time of zinc-iron or some other couples. A strip of commercial zinc exposed to a trickling stream of water in a glass container, develops within 24 hours a series of spots of white products. If these be removed and the zinc be cleaned the formation recurs on further exposure to the water in the same spots distributed irregularly over the surface, but persistent each in repeated experiments. With galvanized iron the action is similar; the initial distribution of effected spots on the coating is persistent, and seems to indicate the location of a series of couples which accelerate the destructive action.

This trouble is not confined to St. Louis, nor to cities using softened waters. To a greater or less extent it probably prevails wherever coagulants are used. And in every case where the occurrence of zinc in a water conveyed through galvanized pipes is noted there should be taken up the consideration of the effect this slow uncovering of the iron body of the pipe will have upon the life of the installation. The purpose of this note is to call out statements of facts and discussion of a known situation. Eventually, perhaps, there may be found a substitute for zinc as a protective coating which will obviate the troubles arising from the high solution tension of zinc.

PEAT AS A STEAM FUEL.*

W. G. Milne, Hamilton, Can.

We will consider peat for use as a steam fuel only in the following forms, so far as I know, they are the only ways in which it is obtainable for commercial uses at present:—(1) Cut Peat. (2) Machine Peat. (3) Briquetted Peat. (4) Dust Peat, or Peat Powder.

Raw Peat, as is well-known, contains at saturation about 90 per cent. of water, but this water content may be lowered by efficient drainage. With this content of water, it is manifestly impossible to burn it for any purpose whatever, and, we have found by the use of partly dried peat for part of one season, that the moisture must be reduced to about 35 per cent. before a fire can be made to burn at all briskly, or reach any high temperature. And it seems that in burning peat in any of the first three ways which require a grate of some kind, moisture up to 36 per cent. produces no bad effects unless it be that the maximum temperature attained is lowered, but there appears to be no loss in steam-raising power due to this moisture, although its effect would be apparent, no doubt, in a calorimeter test.

We used cut peat at our plant for part of one season, but its poor steam-raising power, together with the difficulty in handling and drying made it so unsatisfactory, that it was soon discarded as being too costly.

In the use of machine peat there is no doubt that it can be used very successfully as a steam fuel, provided it can be sold at a price which will compete with the anthracite coal. In many large plants they use so much fuel for producing heat for one purpose or another, that they are equipped with stokers and are thus able to do with few firemen and cheap coal, and machine peat would have to be made a most attractive proposition to offset these features, as it would require more firemen as well.

Briquetted Peat stands in the same class, in almost all particulars, as machine peat with regard to its uses in this respect. In the plant owned by Dr. McWilliam, we have often used the briquetted fuel under the boiler at times and found at no time any trouble nor indications that it would not keep up steam; and we considered that with it we could easily fire the boiler above its nominal capacity, if required.

With respect to Dust Peat, I have no doubt in saying that it is the best and cheapest way of generating power from peat, known at the present time, and I think that the advantages of its use for generating power by means of steam boilers and engines will only be eclipsed when a gas producer is invented which makes the gas direct from peat dust.

We have been obtaining our power by the use of dust peat during the last season, and may best explain its use by describing our application and apparatus. In our process, we find that the average moisture of the peat as picked up by the collector, is between 22 and 25 per cent. This is reduced to about 15 per cent. for briquetting, and, as the peat comes from the dryer, it is elevated to the top of our building and from there, passed out into heaters, through a chute, at an angle of about 45 degrees.

Opening from the bottom of this chute, and near its upper end, is a pipe leading down to a bin which holds about 1,000 pounds of peat. The peat in this bin has about 15 per cent. moisture. From this bin, the peat is fed, as required, by the amount of fire wanted, into a grain grinder, which so reduces it that all would go through a 16-mesh screen, but only 24 per cent. would go through 80-mesh. This grinding is, we realize, to waste, but we have not yet made the necessary changes to get finer dust.

As arranged at present, all dust from the grinder is blown through four-inch pipe into the boiler furnace where it burns like gas. At the present all we use to control the fire is a throttle valve on a small engine which drives both grinder and blower, thus, by slowing up, we get less fire.

We find that while carrying a load of about 55 horse-power, in addition to the engine operating the grinder, which takes steam to give us another 12 horse-power on the large engine, we burn about 300 pounds of dust at 15 per cent. moisture every 22 minutes; this gives us a consumption of about 280 pounds per hour, or, about 4.2 pounds of peat dust per horse-power hour, which, at a cost of Dust Peat to a consumer of $2.50 per ton would give him one horse-power 10 hours per day per year, of about $14. This figure of $2.50 per ton I may add is chosen because it is about one-half of the sale price of our briquetted peat, and does not indicate the cost of production of the dust.

*(Read at the meeting at the Jamestown Exposition).

MILD STEEL EMBEDDED IN CONCRETE.

Sir John Brunner requested the National Physical Laboratory to report "On the Effect Produced on Samples of Mild Steel Embedded in Concrete." Dr. Glazebrook and his staff conducted the experiments and report as follows:—

"A strong wooden box was made and divided into five partitions, each partition being 12 in. long, 7½ in. wide, and 7½ in. deep. Specimens of mild steel of the following dimensions were prepared: 1. One inch diameter, 8 in. long, turned all over. 2. Eight inch lengths cut from a 1½ in. by 1½ in. bar with the scale left on. The partitions were half-filled with good Portland cement concrete, and a specimen of each kind laid on the top, and the partitions were then filled up. This was done on December 21st, 1906. The blocks were covered with water several times a week for a year, and for three months afterwards were left in the open subject to the weather. On April 20th one of the blocks was removed from the box and broken up, and the specimens removed. On examining the specimens carefully no trace of any action by the cement could be detected. The turned specimen was practically as bright as when it was put in, and the scale on the rough specimen was undisturbed. To test the possibility of any slight action the surface of the turned specimen was polished, etched and examined under the microscope side by side with a specimen of the same material cut from the centre of the bar. No difference in the micro-structure of the two specimens could be detected, and the conclusion is that in sixteen months no action has taken place between the metal and the concrete. It is proposed to immerse one of the remaining blocks in the comparatively warm water of the cooling pond for six months and then to examine the specimens—R. T. Glazebrook, Director, May 1st, 1908."

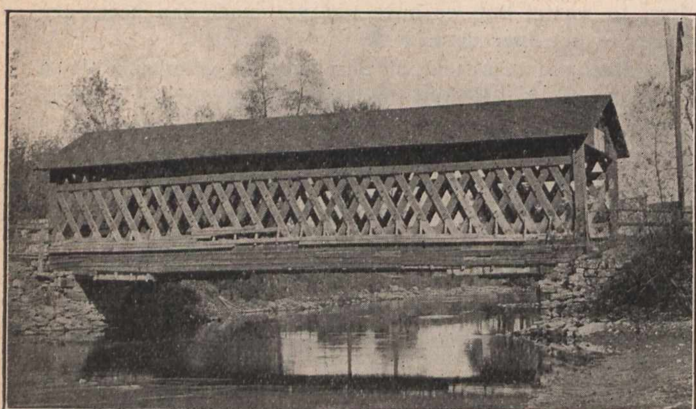
CORRESPONDENCE.

[This department is a meeting-place for ideas. If you have any suggestions as to new methods or successful methods, let us hear from you. You may not be accustomed to write for publication, but do not hesitate. It is ideas we want. Your suggestion will help another. Ed.]

COVERED HIGHWAY BRIDGE.

Sir,—Just outside of the town of Napanee there is a covered highway bridge, a short description of which may be of interest to engineers, not so much because of its value as a model design, but rather more as a curiosity in highway bridge construction.

The bridge was built in 1840, good, white pine being the principal material of construction. To-day, the upper



Side Elevation.

parts are well preserved and in good condition, but the lower chords are much decayed. The southern end is badly out of true, as may be seen by the end view photo, the top being canted considerably to the west.

The bridge is built of plank, 12 feet by 2½ inches, pinned together with 2 inch oak pins wherever they cross. The heads of these pins may be seen in the elevation. The webb members have two pins at each intersection and four for the chords. The top chord consists of four planks; three feet below that, centre to centre, there is a row of planks,

End View.

one on each side, the same from the bottom up. There is no provision for reinforcements for the join in the plank of the chords—they are simply break-jointed. The bridge is 20 feet, centre to centre, and the length 79 feet over all, the height, top chord to bottom chord, 16 feet.

From the photos you will see that there are twenty-four panels. The floor beams are spaced every other panel. The end posts consist of four planks, 12 feet by 2½ inches, placed two on each side, and fifth plank, 16 feet by 2½ inches, to cover up the ends. The top lateral bracing is of a good, substantial character.

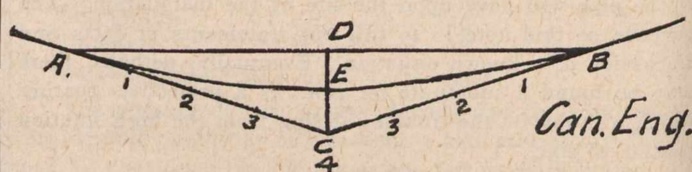
Yours, F. F. Miller.

Napanee, Ont.

VERTICAL CURVES.

Sir,—The following method of dealing with vertical curves may be of interest to some of the readers of your correspondence column. It is comparatively simple and easily remembered:—

$$\text{Length of vertical curve required} = \frac{\text{Algebraical diff. of rates of intersecting grades,}}{\text{Permissible rate of change of grade on curve.}}$$



$$\text{Ordinate DE or CE} = \frac{1}{2}\ \frac{\text{Elev. A + Elev. B}}{2} - \text{Elev. C.}$$

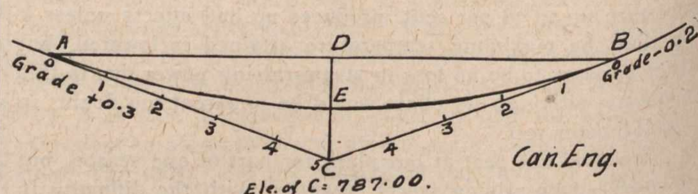
Ordinate of intermediate points (1 2, 3, etc.) =

$$\frac{\text{DE (or CE)}}{(\text{Dist. of point from A or B})^2}.$$

Example:—Let the two grades be + 0.3 and — 0.2 and the permissible rate of change of grade per station on the curve in sogs, say, .05 feet.

Length of curve $= \frac{.5}{.05} =$ ten stations, BC and EC to be five stations each way from grade intersection.

Elevation grade intersection = 787.00, say;
then elevation BC (point B) = 788.00
and elevation EC (point A) = 788.50.



$$\text{Then ordinate CE} = \frac{1}{2}\ \frac{788.50 + 788.00}{2} - 787.00 =$$

0.625 feet.

Then ordinate distances to be added (in this case) to elevations of points 1, 2, 3 and 4 to obtain elevations for the curve at these points are fractional of the ordinate CE (.625) as the distance in stations, squared, of the point under consideration from the BC or EC of curve. Thus, 1/25, 4/25, 9/25 and 16/25 of 0.625 feet, respectively, added to the elevations of the points 1, 2 3 and 4 will give the elevations required for the curve. At a summit these will be subtracted.

Yours truly,
J. V. Dillabough.

Dugald, Man., May 23, 1908.

WINTER LOCATION ON THE G. T. P.

Sir,—As you sat in your warm, cheery home one evening in January last, when outside the thermometer stood 10 deg. below zero and the wind drove the snow as if it would penetrate even to your cosy retreat, as you sat enjoying the pleasant feeling which comes from a physical condition perfectly satisfied, you thought, perhaps, of the poor fellows who were not so happily situated, and you were sorry. But did you ever think of the men who, that same night, were far away from the comforts of civilization, and who, while you were enjoying your after-dinner smoke before a warm fire, sat in their little canvas tents, crowded around a small sheet iron stove, some talking, others

Camp at Robinson Lake.

puffing away silently at their pipes, thinking, perhaps, how, just for one night, they would like to change places with you. Or, as you travel west on the great transcontinental line of the C.P.R., through almost ceaseless forests and boundless prairie, comfortably ensconced in your parlor car, do you ever stop to think of the terrible hardship those pioneer engineers must have endured in order that you might have that particular degree of comfort you are at the moment enjoying?

When one considers the tremendous difficulty experienced in obtaining supplies and in securing materials, the miles that these often were carried through primeval forest, one can but think that those pioneer engineers must have been made of the right kind of stuff.

Winter, when it comes in the North, comes suddenly, and it is unsafe for one to be in the bush with a canoe later than the middle of October. Any morning a thin sheet of ice is likely to be found formed across your creek, and this spells disaster, unless you are well provided with supplies to last until the ice becomes strong enough to permit of travelling on it. I well remember one such morning early in October, 1907, when camped on Johnson Creek, a tributary of the Kawa-kash-ag-ama River, which is Hudson Bay water. A canoe move of forty-five miles had been planned, but on rolling out in the morning we found a foot and a half of snow on the ground and the creek frozen over. Only one of the five tents contained a stove, we had no toboggans or snowshoes, and our provisions were low. We had to move, and by canoe. Ordinarily, the trip would have taken two days, with the camp outfit to portage, but with the ice the time was doubled. We made only four miles the first day and punctured two canoes. The second day the big canoe, carrying the cook outfit, sank in midstream, and had to be raised and floated. On the fourth day we ended by hauling our canoes to the shore over the ice and camping at eight o'clock, in the dark, one mile from our destination, practically without provisions.

The regular life of a winter camp is much of a routine. The day begins with the sonorous "Roll Out!" of the cookee at six o'clock. Turn about is taken by the occupants of the tent in lighting the fire, and it is a cold job, rolling out of warm blankets into a temperature of 60 deg. below zero to start that fire. Breakfast of warm tea, pork and beans, and frequently frozen bread, constituted our meal, which was quickly finished, and then we were ready for work as soon as there was sufficient daylight. No cold weather ever kept us from our line work.

At eleven o'clock two men were detailed to prepare lunch, which is rather a complicated matter in the bush. A dry tree is found, cut for fuel, and a huge fire lighted. A pail of snow is slung over the fire to melt for tea water. Two or three small trees are cut to serve for seats, and brush is strewn around the fire on the snow to keep the moccasins dry, for once they become wet and frozen it is next to impossible to keep the feet from freezing. By this time it is twelve o'clock, and a dozen cold, hungry men crowd round the fire for their hot tea, bread and cold pork, which is the regulation noonday lunch. At one o'clock everyone is again at work, which continues steadily until quiting time, when all file back to camp, with pictures of hot pea soup and a good, warm supper in mind. Supper over, everyone is glad to get as near the stove as possible and enjoy the warmth and comfort of the tent.

Move-day comes round in winter as well as in summer. To a stranger the scene might appear novel and picturesque, but familiarity does not breed enchantment in this case, especially when cold fingers refuse to tie hard knots. Tents are pulled down, toboggans loaded, the dogs hitched, and in an hour everyone is on the move. Care is taken in choosing a camping-place to secure one where there is an abundance of dry wood and plenty of water. Making camp in winter is quite an elaborate undertaking. The tents are pitched on top of the snow, which has previously been tramped with snowshoes to make a firm, level floor, and over the snow spruce brush is laid after the sides of the tent have been securely fastened to keep out the wind. Stoves are then put up and a supply of wood cut for the night. Additional brush must be gathered for the beds, which is laid upon the other brush, and upon this is spread your tarpaulin and blankets.

Winter location is always attended with more or less difficulty, and in some regards is not very satisfactory. The depth of snow handicaps the men on line, even when supplied with good snowshoes. The ground being frozen, the driving of hubs and stakes is likely to prove troublesome. It is often impossible to put in permanent stakes, and the snow has to be cleared away to the ground to get the hubs driven at all satisfactorily. Even the solid hubs in the spring, when the frost is leaving the soil, are heaved and thrown out of line so that other methods must be adopted in order to lay down a permanent alignment. The best plan seems to be to get the hubs of the tangents, as

Dog Team at Height of Land Cache.

often as possible on a tree root or low stump; then in the following spring these tangents may be readily picked up and run to intersection, and the curves re-run; or the points may be referenced on convenient stumps, and these can then be easily used in the re-location. In levelling care is taken to make low bench-marks, so that another coming over the work after the disappearance of the snow will not need to erect a miniature scaffolding in order to read the elevation. Apart, however, from these few mechanical difficulties, a good general knowledge is gained of the country and a fairly accurate survey obtained. Winter location may be carried on in some districts with much greater facility than work in the summer. So long as the cold is not intense it is really quite pleasant work. There are no flies or mosquitoes, and the good trails which the snow affords form a ready solution for the transportation problem.

After a long winter in camp the first signs of spring are welcomed with great rejoicing. The sun comes out bright and warm at noon, snowshoes begin to give out, and an occasional mosquito may be found, endeavoring to limber up its stiffened wings. From the first speculations rise as to the probable date of the coming of the first mail. Long hazards are made and wagers laid and a general air of expectancy seems to pervade the whole camp. Low land begins to assume the appearance of small lakes, creeks the proportions of rivers, and streams rush along, pouring forth many times their ordinary volume of water.

The foregoing few occurrences serve in giving a short resume of a winter in the bush. Our winter began, with the exception of two or three weeks of Indian summer, in October. The first winter mail then arrived a week before Christmas, and the last went out in April. We moved across Lake Nepigon on the 24th of May, the ice breaking up the 15th of June. We did not receive our first summer mail until July 2nd. Is it any wonder, then, that spring in the bush is long looked forward to by all?

Yours truly, E. R. Gray.

Ombabika, 1908.

ENGINEERING SOCIETIES.

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

CANADIAN STREET RAILWAY ASSOCIATION.—President, E. A. Evans, Quebec; secretary, Acton Burrows, 157 Bay Street, Toronto.

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

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, J. Galbraith; Secretary, Prof. C. H. McLeod. Meetings will be held at Society Rooms each Thursday until May 1st, 1908.

QUEBEC BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Chairman, E. A. Hoare; Secretary, P. E Parent, Po. O. Box 115, Quebec. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—96 King Street West, Toronto. Chairman, C. H. Mitchell; Secretary, T. C. Irving, Jr. Traders Bank Building.

MANITOBA BRANCH OF THE CANADIAN SOCIETY OF CIVIL ENGINEERS.—Chairman, H. N. Ruttan; Secretary, E. Brydone Jack. Meets first and third Friday of each month, October to April, in University of Manitoba.

ENGINEERS' CLUB OF TORONTO.—96 King Street West. President, J. G. Sing; secretary, R. B. Wolsey. Meeting every Thursday evening during the fall and winter months.

CANADIAN ELECTRICAL ASSOCIATION.—President, R. S. Kelsch, Montreal; secretary, T. S. Young, Canadian Electrical News, Toronto. The Eighteenth Annual Convention will be held in Toronto, June 17th to 19th, 1908.

CANADIAN MINING INSTITUTE.—413 Dorchester Street West, Montreal. President, W. G. Miller, Toronto; secretary, H. Mortimer-Lamb, Montreal.

NOVA SCOTIA SOCIETY OF ENGINEERS, HALIFAX.—President, R. McColl; Secretary, S. Fenn, Bedford Row, Halifax, N.S.

AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS, TORONTO BRANCH.—W. G. Chace, Secretary, Confederation Life Building, Toronto.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—29 West 39th Street, New York. President, H. L. Holman; secretary, Calvin W. Rice.

SOCIETY NOTES.

Institute of Electrical Engineers.

At a recent meeting of the Institute of Electrical Engineers of Great Britain Mr. Charles C. Garrard read a paper on "Switchgear Control Apparatus and Relays for Alternating Current Circuits." The author said that the installation of control relays on high-tension alternating current circuits had become standard practice, and was likely to continue so. The correct design and lay-out of such relays was of the highest importance, as on their proper action a large part of the success of the system depended. In view of this fact, it was somewhat remarkable that many systems in operation to-day were designed on wholly erroneous lines. This was probably due to two causes: one the attempt to achieve apparent economy; the other being the fact that the relay control apparatus had not been deemed worthy of great attention in comparison with the performance of generators and prime movers. Reference might be made to the Merz and Price's systems, which possessed the advantage of doing away with potential transformers. At the present time it was general practice to install time-element maximum circuit-breaking devices, in various positions, on all large systems. The necessary and desirable time elements of the circuit breakers on each system must be determined experimentally. When installing maximum relays, therefore, they should be such that their time elements might be varied within wide limits independently of the currents at which they operated. The time elements of all the circuit breakers on the system must be considered as a whole, and after the correct values had been found the settings need never be altered.

Iron and Steel Institute, England.

Before the annual meeting of the Society Dr. T. E. Stanton gave the results of a recent investigation into the properties of certain samples of steel rails carried out at the National Physical Laboratory for the Great Northern Railway Company. In the tests were included hardness, impact, and abrasion tests, the tensile and drop tests having been already made. Dr. Stanton felt strongly, however, that a test that would give a combination of rolling abrasion and alternate bending would be invaluable. Dr. Stanton described how this test could be carried out. A hollow ring of rectangular section would be cut from the rail to be tested, and placed between three hardened steel rollers, so arranged as to give a combination of rolling abrasion and bending. The results plotted showed that although, broadly speaking, a high value of the hardness number corresponded to long endurance to alternate stresses and abrasion, yet in several cases an increase in the hardness number was accompanied by a diminution of endurance. Another feature brought out by the tests was the greater endurance of those rail samples of least tensile resistance and greatest ductility, a result probably due to the spreading of the material at the outer surface of the soft steels. A similar effect to this had been observed in practice. The tests further demonstrated the marked superiority of the nickel steel rails both as regarded resistance to rolling abrasion and to alternate bending.

Canadian Society of Civil Engineers.

The result of the ballot which closed on May 14th, 1908, has been announced. The following have been elected:—

Members.

W. L. Mackenzie, Winnipeg, Man.; J. W. Shackleton, Chatham, Ont.; W. A. Pearson, Putnam.

Associate Members.

P. Blair-McCrea, Winnipeg; H. S. Deubelbeiss, Montreal; H. A. Dixon, Winnipeg; J. Drewson, Montreal; A. L. Ford, Eglinton, Ont.; W. J. Fuller, Toronto; F. D. Henderson, Ottawa; J. H. Hunter, Montreal; E. C. Kerrigan, Walkerville, Ont.; T. C. MacNabb, Winnipeg; R. Montgomerie, Montreal; E. O'Sullivan, Montreal; W. D. Pender, Kenora, Ont.; P. C. B. Schioler, Winnipeg; R. Sohier, Montreal; I. J. Steele, Ottawa; F. M. Young, Brandon, Man.; I. W. Watts, Montreal.

Transferred from the Class of Associate Member to that of Member.

C. W. Dill, Toronto; A. F. Macallum, Toronto; E. B. Merrill, Winnipeg.

Transferred from the Class of Student to that of Associate Member.

J. De G. Beaubien, Outremont, P.Q.; T. T. Black, Toronto; L. E. Côté, Ottawa; A. C. Garner, D.L.S., Qu'Appelle, Sask.; E. N. Martin, Moncton, N.B.; J. M. Oxley, Toronto; A. Peden, Jr., Montreal West; C. R. Young, Toronto.

Students.

C. B. Allison, Toronto; G. G. Bell, Toronto; E. W. Bowness, Calgary, Alta.; G. H. Burbidge, Montreal; J. E. C. Bertrand, Montreal; J. C. Brooke, Montreal; G. K. Burnett, New Westminster, B.C.; E. W. Campion, Montreal; F. H. Chesnut, Toronto; L. H. K. Chipman, Montreal; H. A. Cooper, St. Lambert, P.Q.; J. Davidson, Montreal; N. P. F. Death, Toronto; E. Desaulniers, Montreal; A. Findlay, Winnipeg; J. M. Gilchrist, Fredericton, N.B.; L. F. Grant, Prince Rupert, B.C.; P. W. Greene, Toronto; J. A. Guimont, Montreal; G. L. Hall, Isle Verte, P.Q.; E. N. Harvie, Winnipeg; E. Hetu, Upton, Que.; E. Horstmann, Jr., Harrison, N.J.; L. Jacobs, Dryden, Ont.; P. Jewett, Summit, N.J.; P. F. W. Johnson, Montreal; H. G. Lawley, St. Malachie, P.Q.; A. P. Linton, Galt, Ont.; C. Macdonald, Moose Jaw, Sask.; M. J. McHenry, London, Ont.; A. J. C. McLean, Chapleau, Ont.; R. J. McNeil, Sydney, N.S.; E. P. McLean, McDougall's Chute, Ont.; M. K. McQuarrie, Vancouver, B.C.; E. P. Murphy, Ottawa, Ont.; A. M. Narraway, Ottawa, Ont.; C. H. Norton, Montreal; E. Owen, Hazelton, B.C.; E. B. Patterson, Toronto; H. J. Peckover, Toronto; C. A. Robb, Montreal; E. D. Robertson, Ottawa; G. S. Robertson, St. John, N.B.; J. Robertson, Moose Jaw, Sask.; D. W. Robins, Moose Jaw, Sask.; D. Ross, Jr., Montreal; T. D. Ruggles, Fredericton, N.B.; R. T. H. Sailman, Montreal; H. B. Seale, Montreal; A. O. Secord, Brantford, Ont; S. W. Shackell, Lachine, P.Q.; J. N. Sanley, Kingston, Ont.; H. W. Stewart, Baker Lake, N.B.; H. W. Sutcliffe, Toronto; H. Thorne, Montreal; A. G. Tweedie, Sault Ste. Marie, Ont.; H. H. Vroom, St. Stephen, N.B.

ORDER OF THE RAILWAY COMMISSIONERS OF CANADA.

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

4734—May 26—Restraining the C.P.R. from diverting or in any way interfering with the public road crossing in the Parish of Brighton, County of Carleton, N.B., pending disposition of application of C.P.R. for the allowance of its plans for such diversion.

4735—May 14—Authorizing W. E. Foster, President of the St. Martin's Railway Company, to prepare and issue tariffs of tolls to be charged by that railway.

4736—May 26—Authorizing the City of Peterborough, Ont., to lay a water pipe under the tracks of the C.P.R. at George Street, Peterborough, Ont.

4737—May 26—Authorizing the City of Peterborough, Ont., to lay water pipe under the tracks of the G.T.R., where the same crosses George Street and Romaine Street, Peterborough, Ont.

4738—May 26—Authorizing the C.P.R. to construct bridge No. 8.2 crossing the Bay of Brome Lake, Drummondville branch, C.P.R.

4739—May 26—Authorizing the W.E. and Lake Shore R.R. to carry its telephone wires across the tracks of the Michigan Central R.R. at Leamington, Ont.

4740—May 26—Authorizing the W.E. and Lake Shore R.R. to carry its telephone wires across the tracks of the Michigan Central R.R. at Essex, Ont.

4741—May 26—Authorizing the Bell Telephone Company to carry its telephone wires across the tracks of the G.T.R. at Victoria Avenue, St. Lambert, P.Q.

4742—May 26—Authorizing the C.P.R. to construct a bridge over the Yamaska River, at St. Hyacinthe, P.Q.

4743—May 26—Authorizing the Milestone Farmers Mutual Telephone Company to carry its wires across the tracks of the C.P.R. at Milestone, Sask.

4744—May 26—Authorizing the Innerkip Rural Telephone Association to carry its telephone wires across the tracks of the C.P.R at the Centre Town Line, Fourth Concession, Township of Blandford, Ont.

4745—May 26—Authorizing the C.P.R to construct its siding, south of its present main line, across the public road on Lot 1, in the Parish of St. Clements, Municipality of St. Andrews, Man.

4746—May 7—Authorizing W. G. Trethewey, Toronto, Ont., to lay a water pipe under the tracks of the C.P.R. near Weston, Ont.

4747—May 13—Authorizing the Township of Cornwall to make certain improvements on the south branch drain Township of Cornwall, County of Stormont, Province of Ont., upon and across the right-of-way and track of the O. & N.Y.R.

4748—May 15—Authorizing the Crow's Nest Pass Electric Light & Power Company to carry its electric light and power wires across the tracks of the British Columbia Southern Railway Company, at Michel, B.C.

4749—May 26—Authorizing C.P.R. to construct bridge No 53.53 over Jack Fish River Nepigon Section, Ont.

4750—May 26—Authorizing the C.N.Q.R. to cross the line and track of the National Transcontinental Railway by means of a sub-crossing between the pedestals of the N.T. Company viaduct at Cap Rouge, P.Q.

4751—May 26—Authorizing the C.P.R to construct, maintain and operate a branch line of railway or spur to and into the premises of Messrs. Gallagher, Holman & Lafrance, Port Arthur, Ont.

4752—May 14—Approving proposed deviation of the line of railway of the New Brunswick Railway Company from where it is already constructed at or near Theriault, County of Madawaska, N.B.

4753—May 7—Authorizing the Provincial Natural Gas & Fuel Company to lay a gas pipe or main under the tracks of the G.T.R. between Lots 12 and 13, 1st Concession, Township of Humberstone, Ont.

4754—May 12—Requiring the G.T.R. Company and C.P.R. Company to provide certain protection at street crossings in the village of Lennoxville, P.Q.

4755—May 14—Authorizing C.P.R. to construct certain branch lines of railways or spurs at Calgary Junction, on the north half of Section 1, Township 24, Range 1, West of the 5th Meridian.

4756—May 12—Authorizing C.P.R. to construct its bridge at mileage 19.86, Farnham Section, crossing Richelieu Street, St. Johns, P.Q.

4757—May 14—Authorizing the Guelph & Goderich Railway Company to construct its railway across the highway in the Township of Wellesley, County of Waterloo, Ont., at mileage 20.5.

4758—May 15—Authorizing the Crow's Nest Pass Electric Light & Power Company to carry its electric light and power wires across the track of the British Columbia Southern Railway at Gemmill Street, Fernie, B.C.

4759—May 14—Authorizing the Bell Telephone Company to carry its telephone wires across the tracks of the Pere Marquette Railway Company at public crossing one mile southwest of Ruthven Station, Ont.

4760—May 14—Authorizing the G.T.R. to operate its trains over its line of track where the same crosses the Oshawa Street Railway Company track on Simcoe Street, Oshawa, Ont., without being brought to a stop.

4761—May 22—Extending for a period of three months from May 22, 1908, the time fixed for the commencement and completion of the Union Station at Toronto, Ont.

4762—May 6—Authorizing the Dunnville Consolidated Telephone Company, Ltd., to carry its wires across the tracks of the G.T.R. at Shetland Street, Caledonia, Ont.

4763—May 27—Approving location of the Ontario Power Company of Niagara Falls, Ont., from a point in Lot 22, Concession 6, Township of Crowsland, County of Welland, Ont., to a point in Lot No. 17, Concession 5, in the said township, a distance of 1.97 miles.

4764—May 27—Authorizing the G.T.R. to construct, maintain and operate a branch line or spur to and into the premises of Thomas Wilson on Lot 12, in the Junction Gore Concession of Township of Gloucester, County of Carleton, Ont.

4765—May 27—Extending until June 30th, 1908, the time within which the G.T.R. shall provide certain protection at the junction of St. Ferdinand Street and Notre Dame Street West, in St. Henri, Montreal, where the G.T.R. tracks cross the track of the Montreal Street Railway Company.

4766—May 27—Directing the C.P.R. to place and maintain an electric bell where its line crosses Dorchester Street in the City of Quebec, P.Q.

4767—May 27—Amending Order No. 4,466 of March 16th, 1908, authorizing the Windsor & Tecumseh Electric Railway Company to cross the track of the G.T.R on the line of Sandwich Street in the town of Walkerville, Ont.

4768—May 27—Authorizing the Kingston & Feldspar & Mining Company to carry its telephone wire across the track of the K. & P. Railway, three miles north of Verona, Ont.

4769—May 27—Authorizing A. L. Benn, of Long Lake, Ont., to carry telephone wires over the track of the K. & P. Railway at Parham, Ont.

4770—May 27—Extending until December 1st, 1908, the time within which express companies in Canada, subject to the jurisdiction of the Board, shall file and receive approval of tariffs of tolls.

4771—May 27—Extending until 1st December, 1908, the time within which the Bell Telephone Company of Canada shall file and receive approval of its tariffs of tolls.

4772—May 27—Extending until the 1st of December, 1908, the time within which the North American Telegraph Company shall file and receive approval of its tariffs of telephone tolls.

4773—May 27—Temporarily approving, until 1st December, 1908, the freight and money receipt of the Maritime Express Company.

4774—May 27—Temporarily approving, until December 1st, 1908, the forms of contract of the United States and Great Northern Express Companies.

4775—May 26—Temporarily approving, until December 1st, 1908, the forms of contracts of the Pacific Express Company.

4776—May 27—Temporarily approving, until December 1st, 1908, the forms of contracts of the National and American Express Companies.

4777—May 26—Temporarily approving, until December 1st, 1908, the forms of contracts of the Dominion and Canadian Express Companies.

4778—May 26—Authorizing the Bell Telephone Company to carry its wires across the tracks of the G.T.R. at private property, 75 yards north-west of Midland Station, Ont.

4779—May 26—Approving revised location of the G.T.R. branch line to the premises of the Matthew Brothers, Ltd., along Stirling Road, Toronto, Ont.

4780—May 26—Approving revised location of C.P.R. second track of mileage 0.0, Ignace, Ont.

4781—May 27—Ordering the G.T.R. Company and the Wabash Railway Company to interchange passenger tickets between all stations in the Province of Ontario through which the railways of both companies run passenger trains, and that each of the said companies account to the other for the revenue earned upon the tickets so interchanged.

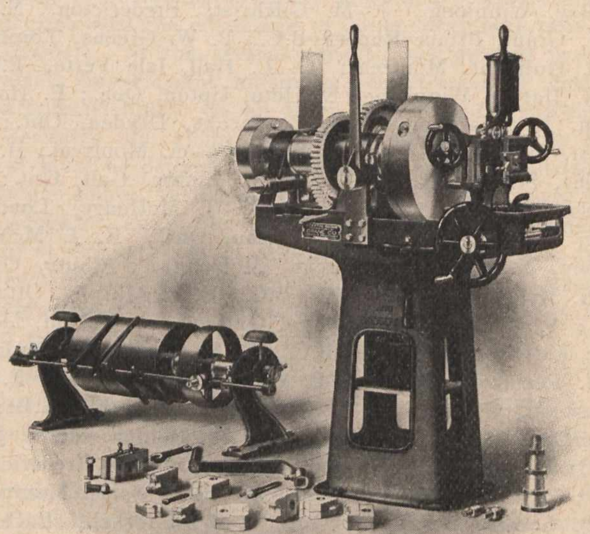
NEW CRANE PIPE MACHINE.

This machine is placed on the market to meet the demand for a low-priced machine, operated by hand or power, for high-class service. All parts have been designed to withstand any strains that such a pipe cutting and threading machine may be subjected to. Simplicity of operation, adjustment and arrangement has been carried out to the minutest detail.

This tool possesses many features which increase output and facilitiate ease of operation. The gripping, threading, cutting-off and adjustment have been so arranged that no unnecessary operations are required.

The frame is one casting, having bed and stand in one piece, eliminating the use of light logs and giving greatest rigidity with minimum weight and floor space.

The die head is bolted to a movable carriage, with ample travel. Upon the die head are the dies, pipe guides and cutting-off tool. The dies are of the improved adjustable type, made collapsible, and are similar to those supplied in Crane hand die stocks. The dies are carried in suitable frames, sliding in guides. These frames are moved by a screw operated by a hand wheel. The dies are set to gauge by a simple locking device, which allows any number of pieces of pipe of the same size to be threaded without any



further adjustment. These dies have four cutting edges and will give good service on either steel or wrought iron pipe. Dies are made interchangeable and one die of a set may be replaced if broken, thus reducing the repair bill to the minimum. Dies, when not in use on the machine, may be used in a hand stock. Change in size of dies may be made in a few seconds.

When cutting-off, the pipe is guided by two steel guides, hardened on the face. These guides are operated by a right and left screw and hand wheel. The cutting-off tool is operated by a lever and rack. This makes a rapid, simple and positive device, and extremely powerful.

The gripping chuck is of the quick gripping type, rapid in action and very powerful. Pipe may be released and gripped by the throwing of a lever without stopping the machine. The chuck is adjustable to the different sizes of pipe within range of the machine, without moving or altering the jaws. The jaws are of a tool steel carried in steel holders and are removable for grinding or replacing.

The rear end of the spindle contains a universal centreing chuck, compact in design and readily adjusted to the various sizes of pipe.

Oil is supplied by a small tank supported on a swivel joint above the die head. A second small tank is placed in the frame, and to this the oil from the dies returns, the supply being controlled by a pet cock.

One pulley is necessary to drive. Three changes of speed are obtained by gears which are shifted by a lever placed on the frame. This device is positive, simple, and cannot get out of order. All machines are supplied with necessary crank for hand operation.

Dimensions: Countershaft pulley, 9¾ diameter x 3½-inch face; countershaft speed, 200 R.P.M.; floor space, 44 x 23 inches; weight, 700 pounds.

DETERMINATION OF THE AREA OF WATER-WAY REQUIRED.

E. A. Harrison, B.A., Sc.

The determination of the amount of water-way required in any given case is a problem that does not admit of any exact mathematical solution. Although the proportioning of culverts is in a measure indeterminate it demands an intelligent treatment. If the culvert is too small, it is liable to cause a washout, entailing possibly loss of life, interruptions of traffic, and cost of repairs. On the other hand, if the culvert is made unnecessarily large, the cost of construction is needlessly increased.

In too many cases the determination of the proper size or capacity of the culverts on a new line of railway does not receive the careful attention its importance demands. Not infrequently it is made a matter of off-hand judgment or guess-work. The engineer walks or rides over the located line looks at the various ravines and streams and from their general appearance at place of crossing, notes the size and character of opening that seems appropriate, and then dismisses the matter from his mind. If he be a man of good judgment and wide experinece these off-hand decisions may not be far wrong. If otherwise, a considerable number, at least, of the water-ways thus determined upon are sure to be either too small or too large. They are more likely to be unnecessarily large, for the engineer knows very well that if a culvert be made too small and be washed out by the first very high water his blunder will come to the attention of his superiors, and he will be unfavourably criticized, while if he makes the water-way unnecessarily large, nobody is likely to discover the fact, and even if it should be discovered he may plead the wisdom of always being on the safe side.

It is anomalous that some engineers who compute with the greatest care, upon elaborate assumptions, the section of every member of a railroad bridge, do not hesitate to guess at the proper size of railroad culverts. It is quite true that the size of culverts cannot be determined with the same degree of accuracy as the dimensions of bridge members, but it is nevertheless entirely practicable to compute the proper area of water-way with approximate correctness by rational methods.

It would seem that in actual practice this question is determined in a number of ways, which can however in general be classified under the following groups: 1. By personal observation, and information collected on the ground, as to flood height, size of channel, openings in the vicinity carrying the same stream, etc. This general information guides in the final selection of the size of the opening, but the actual determination is dependent on practical experience and individual views. It may be said that in the main this seems to be the most usual method. If it can be designated as a method. It is, however, warranted and reliable in flat sections of the country when the bed and contour of a stream at flood-times is known or well defined and the current more or less sluggish at times. It is further probably the best method to pursue in thickly settled sections of the country where other openings on the same watercourse are generally to be found within a very short distance, and satisfactory deductions can be found from a study of these and from information collected from parties familiar with the territory.

2. Drainage areas are prescribed for different sizes and kinds of openings, the limited for each opening allowing variations to be made according to the local conditions, topography, slopes, soil, rainfall, etc. This method has many advantages if a table is prepared with reference to a specific section of the country, so that due allowance can be made for the variable rainfall conditions and the prevailing regional characteristics of the territory embraced. It does not eliminate, however, the personal equation in the question especially as the range of the values in such a table necessarily has to be considerable. It will serve to indicate at a glance the general class of opening required, but the final determination will be dependent on individual judgment and a personal examination of the district.

3. Determination of the area to be drained and of the general characteristics of the country, soil, and stream, which information is used in connecion with an empirical formula giving the area of the water-way required, based upon the drainage area with variable coefficients to suit the different conditions. Considering the allowances that have to be made anyhow, for greater safety, especially so as to provide, more or less, for cloud bursts and unusual contingencies, it can be said that for all minor openings an empirical formula suitably applied and not taken too strictly, supplemented by personal examination of the territory, practical experience and sound judgment, will give as good practical results as minute and careful engineering surveys and calculations. Probaly the best known empirical formula for determining directly the proper area of a water-way and one that has been used most extensively in American railroad practice was advanced many years ago by Mr. E. T. D. Myers, president of Richmond, Fredericksburg and Potomas Railway, namely,

$$\text{Area of waterway in square feet} = C\sqrt{\text{drainage areas (in acres)}}$$

where C is a variable coefficient. For comparatively flat ground or slightly rolling prairie, C is generally assumed as 1; for hilly ground as about 1.5; and for mountainous and rocky grounds as high as 4. In exceptional cases even much higher values have been found to be necessary to correspond to the actual quantity of water as gauged at flood time.

In regard to the proper values for the coefficient Mr. Myers states: "The coefficient should be derived from careful and judicious gaugings at characteristic points within the region under treatment, and applied by a liberal hand."

It is generally claimed that this formula gives too large openings for very small drainage areas. Possibly this might be considered an advantage as very small openings should never be made equal to the theoretical results, but ought to be made larger for practical reasons. Hence the formula in this respect certainly corresponds with practice if not with theory.

It has been generally understood that Mr. Myers intended this formula to apply to minor openings on railroads and not to important streams. For large openings there is no question that a more careful study of the conditions and environment is absolutely necessary, and the sole use of an empirical formula in connection with a coefficient established by snap judgment in the office or a hurried trip over the ground is entirely out of place.

The writer has used this formula in railroad practice, and has found that it has given satisfactory results.

A formula advanced by Professor A. N. Talbot of the University of Illinois, and stated by him to be more as a guide to the judgment than a working rule, is as follows:

$$\text{Area of water-way in sq. ft.} = C\sqrt[4]{\text{cube of drainage areas (in acres)}}$$

in which C is a variable coefficient; for steep and rocky ground, C varies from ⅔ to 1. For rolling agricultural country subject to floods at times of melting snow, and with the length of valley three or four times its width, C is about ⅓; and if the stream is longer in proportion to the area decrease C. In districts not affected by accumulated snow, and where the length of the valley is several times the width, 1-5 or 1-6 or even less, may be used. C should be increased for steep side slopes, especially if the upper part of the valley has a much greater fall than the channel at the culvert. Professor Ira O. Baker, University of Illinois, says in regard to Talbot's formula, that he has tested it and found that it agreed fairly well with the experience of fifteen to twenty years, and that in these tests it was found that the waterways proportioned by this formula will probably be slightly flooded, and consequently be compelled to discharge under a small head, once every four or five years. Empirical Formula, by Mr. Peck (Missouri Pacific St. Louis, Iron Mountain & Southern Railway).

Area of waterway in sq. ft. = drainage area in acres.

4. Careful surveys of drainage area, slopes, gradients and cross sections of streams, determination of velocity of flow by observations and calculations, application of hydraulic

formula to flow of water through various shaped openings under different heads; at different stages of the water height, determination of probable average and maximum rainfall, the volume of water and the time within which it will reach the opening, etc.

From all of which information the shape and size of the opening is determined so as to carry off the water quickly, and without securing the bottom of the stream or injuring the structure.

The efficiency of a culvert may be materially increased by so arranging the upper end that the water may enter it without being retarded. The discharging capacity of a culvert can also be increased by increasing the inclination of its bed, provided that the channel below will allow the water to flow away freely after having passed the culvert. The last, although important is frequently overlooked.

The discharging capacity of a culvert can be greatly increased by allowing the water to dam up above it. A culvert will discharge twice as much under a head of 4 feet as under a head of 1 foot. This can only safely be done with a well constructed culvert.

HUDSON BAY ROUTE TO FORT CHURCHILL.

Possibilities of Country Around for Minerals and Timber.

Winnipeg, June 2nd, 1908.

A representative of the "Canadian Engineer" had an interesting interview with Mr. William Beech, who has been for the past three years at Fort Churchill, on Hudson Bay. Mr. Beech is most enthusiastic about this country, and has every confidence that Fort Churchill will yet be one of the greatest railroad terminals in Canada. The country round about and to within two hundred miles of Fort Churchill will never be anything of an agricultural country, but the whole route up to within that distance will be suitable for agriculture.

On being asked as to the possibilities of Fort Churchill as a harbor, Mr. Beech stated that it was without question the finest natural harbor in the world, and that vessels in pulling out from the dock would in five minutes be into the open waters of Hudson Bay. As a railroad terminus it will become one of the most important in the Dominion, as, with the immense country at the back of it, there is no reason why the Hudson Bay route should not be utilized for drawing the unlimited products of the vast areas of the Western Provinces to the ocean, together with the 300,000 head of cattle which are annually shipped from Canadian ports.

The general layout of the country has been found to be rich in minerals. These are not found, however, in the immediate vicinity of Fort Churchill, but in the district 175 or 200 miles to the north, where gold and copper have been discovered, and if these resources are developed there is great wealth awaiting the prospector. This summer will see the country immediately round Fort Churchill surveyed out as a townsite. A survey party, under the direction of Mr. Marrier, is being sent out by the Interior Department to lay out the townsite of Fort Churchill and the terminus of the proposed Hudson's Bay Railway. The future city will be located on the eastern side of the river, opposite the ruins of Old Fort Prince of Wales, and across the river from the Hudson's Bay Company's trading post. Plans and drawings of the harbor are also being prepared under the direction of the Department.

There is very little timber in the immediate neighborhood of Fort Churchill, but two hundred miles this side abundance of timber is to be found, and the whole country up to the point where the railroad now reaches, namely, Pa Mission, is thickly timbered.

The most convenient way of reaching Fort Churchill from Winnipeg at present is by taking boat at Selkirk to Norway House, thence journeying to Fort Churchill by canoe, a distance of seven hundred miles on the Nelson River. Frequently ten to fifteen portages a day have to be made, which sometimes means having to carry the canoe a distance of five miles. This primitive method of travelling, however, will not be necessary when the new line is completed to the proposed terminus. Three days or less will then be sufficient to cover the distance instead of three months.

AIR RESISTANCE.

Some interesting tests on air resistance employing a novel method have been made by Mr. G. Eiffel in Paris. The method consisted in attaching the surface to be tested to the bottom of a heavy weight and dropping this from the second storey of the Eiffel Tower. A smooth vertical rope, passing through the centre of the surface and of the weight, guided these and also provided a means of stopping them. The total height fallen was about 380 feet. About 65 feet above the ground the diameter of the rope began to enlarge, and engaging with brake shoes brought the apparatus to rest without shock. Apparatus for recording the air resistance, the distance fallen, and the time was fitted to the weight. The test surface was attached to the weight by calibrated springs, the amount of compression of which gave a measure of the air resistance. The surface in moving moved a pointer that pressed against a cylinder covered with smoked paper, and revolved by means of friction wheels rubbing on the rope, and thus giving a measure of the distance. The writing point was carried on one limb of a tuning-fork of 100 vibrations per second. This was set vibrating before dropping the apparatus, and caused the pointer to trace a wavy line. These waves gave a record of the time. Numerous tests with various kinds of surfaces showed that the low $p = K V^2$ is very closely true. The variation of the power of V is small and for practical purposes negligible. The law is actually true at speeds of 100 feet to 110 feet per second. The co-efficient K varies slightly both with the area of the surface and with its shape. Its value is from 0.07 to 0.08, when the velocity is in metres per second and the pressure in kilogrammes per square metre. With V in miles per hour and p in pounds per square foot, the values are 0.0028 and 0.0033. The higher values are reached with large surfaces. The weight of the apparatus was about 250 pounds, and speed up to about 80 miles an hour appears to have been attained. These results will be of great service to those who are collecting data for the design of aeroplanes.

NEW INCORPORATIONS.

New Brunswick.—Runabout Lumber Company, $5,000; G. G. Milburn, H. V. Milbury, Peel; J. Crawford, Aberdeen. H. W. de Forest, $99,000; H. W. de Forest, C. H. Howel, N. P. Shearaton, St. John. Bowman & Cole, $40,000; H. C. Creighton, H. W. Cole, St. John; G. D. Grimmer, St. Andrews.

Toronto.—Canadian H. W. Johns-Manville Company, $50,000; G. W. MacDougall, L. MacFarlane, C. A. Pope. D. McCall Company, $500,000; D. McCall, H. McCall, F. J. Dunnigan. Starkey Manufacturing Company, $40,000; A. N. Starkey, G. B. Jay, A. P. Shields. Heyes Brothers $100,000; H. R. Heyes, C. A. Heyes, F. F. Treleaven,. Commercial Publishing Company, $40,000; G. H. Kilmer, J. A. McAndrew, W. H. Irving. Blackwell Varnishes, $50,000; B. D. Blackwell, W. P. Hirst, E. G. Hirst. Toronto & Niagara Carbide Company, $100,000; Misses M. McPhee, A. B. Reston and L. W. Caton. Keeley Jowsey Wood Mine, $1,000,000; E. W. J. Owens, W. A. Proudfoot, T. Hook.

Britsh Columbia.—Barnet & McDonald Lumber Company, $300,000; Bella Coola Telephone, Light & Power Company, $25,000. Graham Island Coal. Marion Tug-Boat Company, $10,000. News Publishing Company, $50,000. North Coast Commercial Company, $100,000. Northern Trust Company, Prince Rupert, $100,000. Shore Hardware Company, $35,000. Yellow Head Pass Lum[illegible] Co[illegible], $250,000.

BRICK OR CONCRETE AS FOUNDATION FOR BRICK PAVEMENTS.

Many American brick companies had on hand a large number of No. 2 vitrified brick. These were not good enough for pavements, but might answer for foundations. Concrete had for years been used as foundation for brick pavement. Before recommending No. 2 brick for pavement foundation the National Paving Brick Manufacturers' Association requested Prof. I. O. Baker, of Illinois University, to make a series of tests. This Prof. Baker did and reports as follows:—

I made six beams about 30 inches wide and 7 feet long, using Terre Haute and Clinton (Indiana) brick, Chicago AA Portland cement, and ordinary building sand. In mixing and using the grout I followed as nearly as I could the standard specifications of your Association. In making the first beam the grout I followed as nearly as I could the mental beam, and in the confusion resulting therefrom the grout was not kept properly stirred, and consequently the results of the first beam are not satisfactory, and have not been included in the comparisons to be made later. I then made three beams, using standard grout, which seemed to be reasonably satisfactory.

Your standard specifications for the grout were designed for a form of construction whose chief purpose was to protect the upper edge of the bricks in the pavement from chipping; but in the matter in hand the purpose of the grout is to give beam-like action to the pavement. For the first purpose the richest grout should be in the top of the joint, but for the second purpose the richest grout should be in the bottom of the joint. Therefore, I made two beams, in which I used a grout composed of two volumes cement to one volume of sand from top to bottom. I hope to make another experiment, in which I shall use rich grout at the bottom of the joint and the leaner grout at the top of the joint; but in this first experiment I thought it wiser to use the rich grout from top to bottom. It is almost certain that the leaner grout at the top of the joint will not decrease the strength of the beam, and it surely will decrease the cost of the construction.

Below are the results obtained from the six beams which I have thus far broken. The beams were supported at the bottom and loaded at the middle, and all were tested when thirty-three days old:—

Beam. No.		Modulus of Rupture.
1.	Standard grout...	370.4 lbs. per sq. in. Terre Haute brick.
—		———
2.	Standard grout................	678.2 lbs. per sq. in. Terre Haute brick.
3.	Standard grout................	540.8 lbs. per sq. in. Clinton brick.
4.	Standard grout................	603.1 lbs. per sq. in. Clinton brick.
		———
	Average....................	607.4
5.	Grout: 2 cement to 1 sand....	627.2 lbs. per sq. in. Clinton brick.
6.	Grout: 2 cement to 1 sand....	672.4 lbs. per sq. in. Clinton brick.
		———
	Average....................	649.8

The modulus of rupture is the term used by engineers in expressing the strength of a beam. It may be defined to the laymen as the stress in pounds per square inch upon the outside fibre at the bottom of the middle of the beam.

Understanding that you desired these experiments made in order that you might determine whether or not it was practicable to advocate the use of a layer of brick with grout-filled joints instead of the usual concrete foundation for pavements, I presume it will be acceptable for me to offer some comparisons between the strength of such a brick beam and of a similar concrete beam.

Before entering upon this phase of the investigation I wrote to eleven large cities not in Illinois and to eight of the larger cities of Illinois, asking for their specifications for pavements. I did this with a view to finding what grade of concrete was used for pavement foundations. I received replies from fifteen of the cities, but only eleven of them had specifications for brick pavements Below I give the list of the cities, with the kind of concrete which they use. All use six inches of concrete I present first the cities using Portland cement concrete, and, second, those using natural cement concrete.

Portland Cement Concrete for Pavement Foundations.

City.	Cement.	Sand.	Aggregate.	Proportion.
Chicago	1	3	6	1:9
Springfield	1	3	5	1:8
Milwaukee	1	3	6	1:9
Columbus	1	4	9	1:12
Washington	1	4	10	1:14
Paris, Ill.	..	..	..	1:9
Indianapolis	1	3	5	1:8
Philadelphia	1	3	6	1:9

Natural Cement Concrete for Pavement Foundations.

City.	Cement.	Sand.	Aggregate.	Proportion.
Cincinnati	1	2	5	1:7
Louisville	1	2	5	1:7
Paris, Ill.	1	3	3	1:6
Paris, Ill.	..	..	..	1:5
Rockford	1	2	6	1:8

It will be noticed that there is a great diversity as to the proportions of the concrete used in the various cities, and there is still greater variation if we take account of the fact that some proportion the concrete by units of loose cement and some by units of packed cement; and, further, that some use gravel and some use broken stone, and still again some use screened and some use unscreened stone.

I have examined engineering literature with a view of extracting for your benefit data on the modulus of rupture of concrete; but here again I have found such a variety of results that the best data I can find are far from satisfactory. There are the same variations in experiments as I referred to just before in the concrete used in pavement foundations, and in addition the experiments vary because the tests were made with concrete of different ages and different degrees of wetness and stored in different ways—some in the air, some under damp sand, and some under water. Below are some of the most valuable results that I could find:—

Authority.	Age When Tested.	Proportions. Cement.	Sand.	Aggregate.	Proportions.	Modulus of Rupture— Lbs. per sq. in.
Baker's "Masonry Construction, p. 112v.	28 days	1	2½	5	1:7½	144
	28 days	1	3	5	1:8	88
	28 days	1	2½	6	1:8½	81
	28 days	1	2	3	1:5	145
	28 days	1	3	7	1:10	113
A. N. Talbot......	30 days	1	2	4	1:6	208
Falk (p. 147)......	40 "	1	3	6	1:9	170
						———
					Average..	137
Falk (p. 149)......	128 "	1	3	5	1:8	196
Sabin	1 year	1	3	7½	1:10½	204
Falk (p. 146)......	7⅓ years	1	2	4	1:6	296
Falk (p. 146)......	7⅓ years	1	3	5	1:8	228

The above results are all that I can find in engineering literature with any reasonable expenditure of labor, except some results of experiments made by W. B. Fuller, which are quoted in Taylor & Thompson's "Concrete, Plain and Reinforced," pp. 258-59. These results are, in a rough way, about twice as high as those quoted above, due to two things: First, the use of trap rock instead of limestone, and second, to the unusual care in first separating the various sizes and then recombining them in the best proportions for securing the very highest results. With the present ideals and practice of contractors, it is entirely impracticable to mix concrete with the same degree of care and accuracy as is employed in the above experiments; and, therefore, I think that Mr. Fuller's experiments are not applicable in this discussion.

When I began to write this report I thought I had several results for natural cement. but apparently I have only one, namely a result by Sabin for a 1:2:4 natural cement concrete tested at one year, which gives a strength of 159 pounds per square inch. From my general knowledge of natural cement, I am quite sure that this is unusually large, and I think it is safe to say that at a month the strength of natural cement concrete is not more than one-third of that of Portland cement concrete of the same proportions and age. However, this is not a matter of much moment, since Portland is rapidly displacing natural cement; and the fact that a city has specifications permitting the use of natural cement does not prove that it does now use such cement or that it will in the future.

The above data for the strength of concrete are so varied that it is nearly impossible to draw any conclusion as to a representative average. I have tabulated the results in the order of the age when tested, and have included only proportions approximately the same as those previously shown to be in use in pavement foundations. Notice that the average modulus of rupture of the results in the table from 28 to 40 days is 137 pounds per square inch. I intended to break the brick beam when 28 days old, but an accident made it impossible to break the first beam until it was 33 days old, and, as it was desirable to have all tested at the same age, all were tested when 33 days old. The mean age of the first seven results in the above table is 30 days. It is hardly correct to take averages in this way, but for this purpose it is nearly correct to say that the average strength at 30 days is 137 pounds per square inch. I think this result is higher than will ever be attained in a pavement foundation, for you must remember that the above results are from carefully conducted laboratory experiments, while in practice the concrete is mixed by unskilled labor, with the chief object of obtaining an economical result rather than the greatest possible strength.

Preliminary to making a comparison between the strength of the brick beam and a similar concrete beam, permit me to explain that the strength of a beam varies as the square of its depth; and, therefore a beam 6 inches deep will support 2¼ times as much load as a similar 4-inch beam, and practically 3 times (exactly 2.95) as much as a 3½-inch beam, and four times as much as a 3-inch beam.

The brick beam referred to at the beginning of this report, made with standard grout, has a modulus of rupture of 607 pounds per square inch, which is 4 times (exactly 4.05) as much as the assumed average for the modulus of rupture of concrete; therefore, such a brick beam 3 inches deep will carry as much load as the ordinary 6-inch concrete beam, and a brick beam 3½ inches deep will carry 1.4 times as much as a concrete beam 6 inches deep, and a brick beam 4 inches deep will carry 1.8 times as much as a concrete beam 6 inches deep. Further, the beams with the richer grout gave a modulus of rupture of 650 pounds per square inch, and hence such a brick beam will carry 8 per cent. more load, respectively, than the beams just mentioned.

The Department of Mines, Ottawa, will undertake this year important experimental work in respect to the utilization of the large peat deposits scattered throughout the Dominion. The supplementary estimates will include an item for the establishment of an experimental plant, probably in Ottawa, where investigations will be carried on in the methods of obtaining producer gas from peat, and into other modern methods of using peat for various industrial and domestic purposes.

PREIGNITION IN GAS ENGINES.

By W H. Booth.

In the course of a very generally interesting paper on the control of internal combustion in gas engines, presented to the December meeting of the American Society of Mechanical Engineers by Prof. C. E. Lucke there is a very instructive section on preignition, by which, of course, is generally understood ignition prior to the dead point. There are various causes of preignition, some well known, others somewhat obscure. Thus, an inwardly projecting part, such as a ragged edge of asbestos gasket or a rough edge of a casting, the head of a bolt, a nut, or even a bit of carbonized oil may all cause preignitions to occur. A frequent cause is, no doubt, the igniter itself, for it contains projecting pieces. Preignition occurs usually towards the end of the compression stroke, as might be expected. The charge is already heated by compression, and a very little further heat will cause ignition to take place. Preignition may be merely fortuitous, and due simply to the juxtaposition of some overheated projecting piece and a favorably proportioned little eddy of mixture, just about correctly proportioned for easy ignition. The addition to the mixture of a little vaporizing lubricating oil may just turn the scale in favor of ignition. At one time, says the author, hydrogen was looked on as the cause of preignition, the temperature of ignition being lower than that of carbonic oxide, but it does not appear that simply the addition of hydrogen will lower the temperature of ignition, each per cent. of hydrogen being responsible for so many degrees of lowering. Numerous experiments have shown that preignition may take place with low hydrogen and may not occur with high hydrogen, and vice versa, for a given engine and a given compression, but there seems nothing definite to say that if hydrogen were absent there would be no preignition at this compression. From certain investigations carried on at Columbia College and elsewhere it would appear that it is not the percentage of hydrogen present to which preignition is due, but the ratio of hydrogen to certain other elements. Ordinary remedies for preignition are reduction of compression and the introduction of steam or water or cooled and purified exhaust gases. The old values of ignition temperatures of explosive mixtures throw no light on the subject, but more recent determinations do. If a weight be dropped on a plunger closely fitting a cylinder containing a known mixture, the plunger travel may be measured at the point where it is stopped by explosion, and the ignition temperature may be calculated by the adiabatic law from the volume ratio when ignition takes place from compression alone. The following results have been found with various ratios:—

Hydrogen and Oxygen.

Mixtures by Volume.	Atmospheres.	Ignition Temp. corrected for Moisture.
$4H_2 + O_2$	47 maximum	878° C.
$2H_2 + O_2$		813°
$H_2 + O_2$	33 minimum	787
$H_2 + 2O_2$		803
$H_2 + 4O_2$		844

Apparently the lowest ignition temperature is obtained when the oxygen is present in twice the chemical equivalent of the hydrogen. Nothing is said as to how the exact moment of explosion is decided upon, for it cannot surely be assumed that the falling weight is stopped instantaneously by the explosion; nor must it be too hastily assumed that the ignition temperature found by heavy compression would be the same as the temperature of ignition of the same mixture under less pressure. Close compression, no doubt, facilitates ignition. Still, it is probable that the order in which the various mixture ratios stand in the above table would remain the same.

Carbonic Oxide and Hydrogen.

Mixtures by Volume.	Atmospheres, Compression.	Ignition Temp. corrected for Moisture.
$6CO + O_2$	76 maximum	994° C.
$4CO + O_2$		901° C.
$2CO + O_2$	43 minimum	874°
$CO + O_2$		904°

The lowest ignition temperature is obtained with carbonic oxide and the proportion of oxygen chemically equivalent; and it is interesting also to note that if this mixture is departed from the ignition temperature is raised equally, whether the ratio be changed by adding CO or O. Then the addition of neutral nitrogen to the H and O mixtures raises the ignition temperature, and the new temperature for a mixture with N in it becomes T + 30n. Where T is the temperature for a pure H and O mixture and N is

$$n = \frac{\text{Volume of inert gas,}}{\text{Volume of } H_2 \text{ or } O_2 \text{ (whichever is the smaller).}}$$

Thus, if $4N_2$ be added to the $H_2 + O_2$ mixture, the temperature of ignition is raised from 787° C to 907° C.; and so, also, for CO and O mixtures, the addition of N raises the temperature from T to T + 80m. where

$$M = \frac{\text{Volume of inert gas.}}{\text{Volume of CO.}}$$

This formula was found to give the ignition temperatures of producer gas combinations of H, CO and O. If the ignition temperature of the H and O part be calculated, considering the CO as inert, and that for CO and O part calculated, considering the H as inert, then the lower value is found to agree with the observations by test. The conclusion is that the ignition temperature is fixed by the proportions of two of the components of one complex mixture, all else acting to raise the temperature as inert or neutral gases. Trials of alcohol gave 973° C. at 62 atmospheres, and fairly constant for over 100 per cent. variation in quantity, while gasolene (a less complex compound) gave 902° C. with only 47 atmospheres constant for more than 300 per cent. range in quantity.

The ignition temperature of a producer gas does not, in fact, depend upon its contents of H or of CO, but on the relation that one of them bears to the oxygen present, and which one can only be determined by finding the ignition temperature by computation and taking the lower value. But in all this it is to be observed that both temperatures and compressions are higher than any which occur in practice, so that, when preignition does occur, it is due to some special source of heat acting upon some moderately compressed gas. There must be some part hot enough to augment the temperature of the compressed charge at some point whence ignition can be propagated. The problem resolves itself into suitable maintenance of the proportions of the elements of a mixture to those having the higher temperatures of ignition consistently with the preservation of sufficient oxygen to burn all the fuel present; care in securing low initial temperatures by means of cool inlet passages and complete purging of the burnt gases; careful design so as to secure a well-cooled interior, and to avoid heated projecting pieces. If the figures given are reliable they seem fully to warrant the conclusion that the danger of preignition is by no means the outcome of the percentage of hydrogen. At the same time the temperatures of ignition of hydrogen mixtures are seen to be substantially lower than those of carbonic oxide mixtures. Indeed, taking the figures as given, the highest figure for hydrogen is nearly as low as the lowest for carbonic oxide, and the figures do afford ground for the general belief as to the danger of hydrogen, while at the same time showing the direction in which the minimum safety may be secured, apart from conditions of construction. Considering, however, how very much higher than for any compression the figures for temperature are found to be, it is obvious that the primary cause of preignition must always be some projecting point or a bit of glowing carbon, and this points to the impossibility of avoiding preignition absolutely so long as a combustible charge is compressed. Clearly, the correct method of gas engine operation is that of injecting the fuel into the cylinder after compression of the charge of air, ignition being effected either as in the Diesel engine by the ignition temperature of high compression, or as in the Johnstone oil engine by means of an electric spark or a glowing set of special alloy washers standing in the stream of entering fuel.

TRADE INQUIRIES.

The names of the firms making these inquiries, with their addresses, can be obtained only by those specially interested in their respective commodities upon application to: Trade Inquiries Branch, The Department of Trade and Commerce, Ottawa, or the Secretary of the Board of Trade at Halifax, Winnipeg or Vancouver:—

The following were among the inquiries relating to Canadian trade received at the office of the High Commissioner for Canada, 17 Victoria Street, London, S.W., during the week ending May 15th, 1908:—

Fancy Hardwoods.—A firm in Bridgetown, Barbadoes, desires to have correspondence with lumber dealers in Canada wishing fancy hardwoods for furniture and house fittings.

Sawmill Machinery.—A company in Berbice, British Guiana, desires catalogues of sawmill machinery from Canadian manufacturers.

Paris White.—Inquiry has been made by a North England firm for the names of Canadian importers of Paris white.

Steel Rails.—A Tyneside firm of engineering agents are desirous of negotiating with a Canadian firm manufacturing tramway and other rails, with a view to actively representing their interests among corporations and other purchasers.

Timber.—A Manchester timber merchant desires to hear from Canadian firms who cut spruce or other softwood on the rotary principle, ⅜ inch thick, 6 inches to 9 inches wide, and 3 feet 6 inches to 5 feet 3 inches in length.

Wood Pulp, etc.—A London firm of steamship brokers desires to hear from parties in Canada to whom they might be able to be of service. They are also prepared to handle shipments of wood pulp, pulp-wood and other Canadian products.

Gas.—A Lancashire firm desires to hear from parties in Canada who might be interested in their system for manufacturing gas from paraffin oil for the purpose of lighting country towns, villages, etc.

Acetylene Lamps.—A London firm manufacturing portable acetylene lamps desires to hear from Canadian importers of such goods.

Gas Compressor.—A London company manufacturing a patent vacuum gas compressor would like to get into correspondence with Canadian manufacturers of gas fittings, lamps, etc., prepared to take up the sale of their specialty.

NEW INCORPORATIONS.

Pincher Creek, Alta.—Pincher Creek Brick, Power and Light Company.

Montreal.—Bermuda Companies, $100,000; A. A. Allan, C. Morgan, C. G. Heward.

Winnipeg, Man.—Hyndman's, $50,000; G. J. Hyndman, J. W. E. Armstrong, E. R. Lindsay.

Fort William, Ont.—Shaarey Shomayim of Fort William; J. Enzer, M. Marrom, M. Helman.

Hamilton, Ont.—Dominion Tar and Ammonia Company, $40,000; Hon. W. Gibson, Beamsville; D. R. C. Martin, R. C. Fearman, Hamilton.

Quebec Province.—Syracuse Smelting Works of Canada, $250,000; L. Sapery, J. H. Thornell, W. Levine. Montreal; Montreal Union Abitibi Mining Company, $2,000,000; A. Ollier, Sudbury; A. Renault, Ville Marie; W. Damphousse, St. Elizabeth.

THE NECESSITY OF LAYING WATER MAINS WITH THE VIEW OF FUTURE CLEANING.*

Geo. F. Whitney, New York.

The undisputed formation of tubercles on the interior of cast iron water mains, vegetable growth and sedimentation, makes the cleaning of water mains a necessity where they are not replaced by new pipe.

The art of cleaning water mains has been rather dormant in the past, for two reasons—inefficiency and expense—but, the art is becoming more fully understood now and the expense is being reduced, so that it seems that in a short time tuberculated mains, or mains filled with vegetable deposit or sediment, will be regularly cleaned, so that the cleaning of water mains will be recognized as an expense of maintenance, the same as other repair work.

In England it has been the custom for years to lay water mains with frequent openings so that a spiked chain can be passed from one of these openings to another, and by pulling it backward and forward thereby knocking off the projecting tubercles, and with subsequent flushing get the dirt out; but, as can be readily seen, the inefficiency of this method is the reason why it has never been adopted generally.

There has also been some work done at Halifax, Boston, and some parts of Pennsylvania, but the methods used have either been inefficient or prohibitive in cost.

As there are at the present time several contracting companies who have thoroughly efficient apparatus for the cleaning of cast iron water mains, it is time for us to look to the future cleaning of our pipe lines by laying new pipe with that object in view.

Water mains are subject to roughness of the interior and reduction of diameter to three (3) causes; namely, tuberculation, vegetable growth and sedimentation. Any one of these three causes reduces the diameter and increases the friction and so destroys the pressure and flow of the pipe, greatly reducing the carrying capacity originally intended. There is hardly any character of water, or any location that is entirely free from one of these three causes, while there are many waters in which all three of these contributing causes operate.

Of course, tuberculation is much more rapid in some localities with certain character of water than with others, but, I think, it is safe to state that no shed water (I mean by shed water either well water or spring water) is free from either the formation of tubercles, vegetable deposit or sedimentation. Consequently, as the conditions cannot be avoided a remedy must be found; so if this premise is correct and the art of cleaning water mains is sufficiently advanced to be efficient then the future cleaning of water mains must be recognized and provided for.

I think this is all a logical conclusion when the enormous loss of efficiency is considered in tuberculated mains, and I have frequently seen mains cleaned where the increase in flow was from 33⅓ to 178 per cent.

It is not necesary to wait until the diameter of the pipe is reduced to one-third, or one-half, as the loss is not due so much to reduction in diameter as it is to increased friction. It is well to bring this point out so as to urge frequent cleaning, and in that way keep the pipe line constantly up to its normal and full carrying capacity, and avoid the enormous expense of constantly laying new pipe lines to supply a territory which could readily be supplied if the original line was delivering its normal or full carrying capacity.

Of course, these ideal conditions can never be reached until the expense of cleaning is gotten down to such a figure as will allow the cleaning to be a part of the cost of annual maintenance, and this cannot be gotten at until the pipe lines are originally laid with the idea of future cleaning kept in view.

The greatest expense of cleaning water mains at the present time is the frequent breaks which are necessary in the line, as each one of these breaks means digging, breaking the pipe to put in a special fitting, or a new piece of pipe, and all the skilled and unskilled labor attendant upon such work. These and other things largely add to the expense of cleaning water mains, and if they could be gotten rid of the cost of cleaning would be so reduced that any water department could well afford to have the cleaning cost added to the cost of maintenance, and not only let a contract for cleaning when it becomes an absolute necessity.

Mr. N. S. Hill, Jr., shows very clearly in a paper read before this Association last year at Toronto, that if mains were cleaned every five years an expenditure of 2.42 cents per foot per annum would be a justifiable addition to the cost of maintenance. I will not take up your time in reading this deduction of Mr. Hill's, but refer you to last year's proceedings of the Association, which you will find on page 365.

The additional original cost would be relatively small to what the present contract prices necessarily are, and, in fact, the additional cost would be very small at any rate, as a special fitting or hatch box could be inserted every one thousand feet at very little extra expense.

The perfection of hatch boxes would be one that came to the surface and would require no digging, but that would entail a greater original expense; but, a hatch box can be used which would not increase the original expense very materially, but would greatly reduce the cost of cleaning, as a line so equipped would not have to be broken, and that is really the greatest expense incidental to the cleaning of water mains.

If these specials were used it would make the cleaning of water mains a joy to the contractor, and so reduce the expense of cleaning that it would not have to be seriously considered.

Another factor to be considered in the laying of water mains with a view of future cleaning is the economy of time of operation.

At present the minimum time the water is shut off for cleaning purposes is four hours, as the pipe has to be broken, special fittings or a new piece of pipe inserted after the machine has been put in the pipe and then the actual time of cleaning, whereas, if the line was equipped with specials the only time required to have the water shut off would be the actual time of cleaning, which is about forty-five minutes to every one thousand feet.

This would have a twofold value—first, economy of time that water would be shut off from consumers—and second, reduction of fire risks. Of course, at present as soon as the specials are inserted in the pipe line water can be put on the entire line within five minutes, but, while the line is broken for the purpose of putting the specials in, the water is necessarily shut off from that section.

If water mains were regularly cleaned and kept free from any and all roughness on the interior there would be nothing but the normal friction to overcome, and the saving in fuel would probably be sufficient to pay for all cleaning. In one case which I am familiar with the pumps were running at 117 pounds water pressure before the line was cleaned, whereas after it had been cleaned the pumps were run at 109 pounds water pressure and delivered the same amount of water. It has been estimated that from 30 to 50 per cent. more fuel is required where the main is tuberculated, than where the main is free and only the normal friction has to be overcome.

I have given much time and thought to the subject of cleaning water mains, and I am convinced that as the art is brought each year to a higher point of perfection that it is bound to become a part of the annual expense of maintenance and that the future will show the necessity of laying water mains with a view of frequent cleaning.

*Paper read before the American Waterworks Association, Washington.

SUCCESSFUL ASSAYERS.

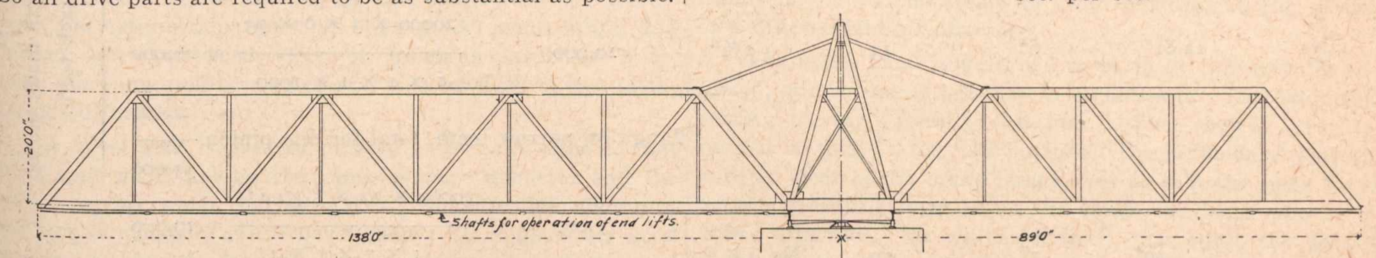
Only two students, Victor Howard, of Victoria, and W. Lindsay, of Trail, presented themselves at the Government Assayers' Examination held this week in the Provincial Laboratory. Both passed very successfully. William P. Robertson, the Provincial Mineralogist, and W. Watson, manager of the Tyee smelter, and D. E. Whitaker, assistant assayer, were the examiners.

EQUIPMENT FOR OPERATING SWING BRIDGE BY POWER.

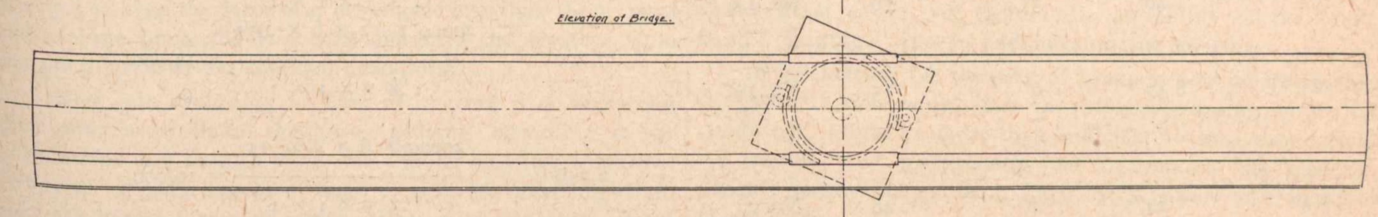
C. J. Fensom, M.E., Consulting Engineer, Aberdeen Chambers, Toronto, Ont.

CONDITIONS:—The bridge referred to in the above is shown in the outline drawing. It has a total length of 227 feet, in two unequal spans of 138 feet and 89 feet. It is counter-weighted at the short end and has a total weight of about 230 tons.

While the bridge is a new structure, yet no provision had been made for attaching a power drive—the old drive mechanism consisting of two sets of gears and two racks, as indicated in drawing 29E1. The bridge is situated where there is considerable traffic, and is exposed to high winds. So all drive parts are required to be as substantial as possible.



Elevation of Bridge.



Plan of Bridge.

TIME OF SWING:—First, the operation of other bridges was carefully watched. Then after carefully considering all special conditions, and examining strength and design of turntable, looking into strains caused when starting and stopping swing, taking into account the fact that heavy gusts of wind get a clean sweep at long span of bridge, only, and that great inconvenience would be caused by a breakdown, it was decided to make the time for opening or closing two minutes (including and stopping).

POWER OF MOTOR:—The power of driving motor was really decided by purely practical conditions and tests. For general work it is often good practice to simply make doubly sure that your motor is large enough. But in this case space and means of proper support had to be taken into consideration, and also the tremendous strain which a large motor might exert on the rack and main pinions and on certain parts of the turntable.

From power tests made on other bridges, and from hand-drive tests made on the bridge to be equipped, it was decided that a 15 horse-power motor would be sufficient for the requirements. The current, to be supplied, is A.C., so this will reduce the risk of damage to motor.

In deciding the power of motor due attention was paid to power normally required, maximum power allowable, nature of friction clutch to be used, etc.

The "rack" is 20 feet 6 inches in diameter. The normal rack speed relative to bridge is to be 8⅓ feet per minute. This means that 10 effective horse-power, at the main pinions, will give a rack strain of 40,000 pounds.

The present low-power man-drive gear gives a ratio of 70 to 1 between the rack and the men (who walk round in a 14-foot circle). The force exerted on rack by three men, when getting speed up on bridge, I estimate to be about 10,000 pounds. When bridge gets under way the men appear to exert about one-third this force. Under these conditions the bridge is swung in about eight minutes, on an ordinary calm day.

A wind makes a very great difference, and a high power gear giving a ratio of about 300 to 1 has occasionally to be used. But all tests with both gears, and a general examination of turntable appeared to show that a force of 15,000 to 20,000 pounds on the rack should swing the bridge under ordinary conditions in the required time, and that a force of more than about 50,000 should not be allowed. (This matter is further referred to when discussing rack and friction clutch).

When making a design it is often well to look into the matter in as many different ways as possible. Very peculiar conditions may exist which may make apparent facts obtained from practical data, very misleading. I am here outlining a rough calculation regarding power required:—

Weight of bridge = 460,000 lbs.
Friction on rollers (at 1.5%) = 6,300 lbs.
Radius of Gyration = (about) 80 ft.
Velocity at this rad. = 8⅓ × 80/10 = 83 ft. per min. = 1.4 ft. per sec.
To give bridge this velocity in 10 sec. f = 1.4/10 = 14 ft. per sec. per sec.

Force required to give this acceleration.

=460,000/1 × .14/1 × 1/32 = 2,200 lbs.

Wind area of long span = 1,000 sq. ft.
Wind pressure of 1 pound per sq. in. (about 15 mile breeze) on long span only would give strain on rack of 6,900 lbs.
Wind area of short span = 640 sq. ft.
Unbalanced wind area = 360 sq. ft. at about 115 feet from pivot.
A 45-mile gale (10 lbs., acting on the whole side of bridge) would exert a strain on rack of 360/1 × 10/1 × 115/10 = 41,000 pounds.

A strong wind, tending to unbalance the bridge, would also greatly increase the turning friction.

This coefficient of friction is assumed as an ordinary maximum after comparing with data on rolling-stock, etc. The friction should be low as there is practically no pressure on journals. The actual ordinary friction appears to be somewhere near 7 per cent.).

General summation:—

Max. ordinary friction = 6,300 lbs.
Inertia resistance = 2,200 lbs.
Ordinary wind resistance = 3,500 lbs.
Ordinary force on rack = 12,000 lbs.
Probable additional resistances of gale = 28,000 lbs.
Total max. strain on rack = 40,000.
Equivalent to 10 horse-power at pinion.
33 per cent. friction = 5 horse-power.
Max. power required at motor = 15 horse-power.

The above figures bring out the importance which must be attached to wind strains, and also at once directs attention to the design of friction clutch and brake.

ARRANGEMENT:—Having decided as to power required and as to speeds, the next matter to be gone into was general arrangement of necessary gearing and best method of attaching parts to bridge.

A careful examination was made of the bridge turntable, etc., and sketches made. The bridge working drawings were referred to.

The arrangement decided upon is shown clearly in drawing 44B2. (For convenience of reference I am also attaching sketch, see page 7).

The design shows two main pinions. This doubles the rack strength and also takes strain off pivot and turntable (one pinion reacts against the other so giving a pure turning couple).

On each pinion shaft is a gear made as large in diameter as space permits. These gears are driven from a second pair of vertical shafts which are themselves driven from a pair of horizontal shafts by means of bevel gears.

strains exerted by a torque equivalent to 15 horse-power at the motor, friction being allowed for sufficient to reduce this to 10 horse-power at rack.

In another column is given the allowable working strains on gears chosen, as calculated by the Lewis formulæ. (This formulæ appears to allow a direct strain factor of safety of from about 4, for the very slow running gears, to about 18, for the motor gearing).

Lewis Formulæ, P.—s. p. f. n.

Gear.	Diam.	Face.	Teeth.	Pitch.	Strain on each at 10 to 15 H.P.	Calculated Working Strength.
Rack	20′ 6″	5″	...	2⅞″	20,000	$\frac{20000 \times 3 \times 5 \times 12}{1 \times 1 \times 1 \times 100} = 36,000$
N1	12.81″	6″	14	2⅞″	20,000	$\frac{20000 \times 3 \times 6 \times 73}{1 \times 1 \times 1 \times 1000} = 26,000$
					flange on narrow teeth, total for one pinion	7,000 / 33,000 (Pinion teeth made thicker than rack teeth.)
N2	40″	5″	70	No. 1¾	7,000	$\frac{20000 \times 12 \times 5 \times .115}{1 \times 7 \times 1 \times 1} = 19,700$
N3	8.57″	6″	15	No. 1¾	7,000	$\frac{20000 \times 12 \times 6 \times .075}{1 \times 7 \times 1 \times 1} = 14,000$
N4	24″	4″	48	No. 2	2,750	$\frac{20000 \times 6 \times 4 \times .11}{1 \times 5 \times 1 \times 1} = 10,000$
N5	7.5″	4″	15	No. 2	2,750	$\frac{20000 \times 6 \times 4 \times .075}{1 \times 5 \times 1 \times 1} = 7,200$
E5	16″	3¼″	40	No. 2½	1,430	$\frac{15000 \times 7 \times 13 \times .11}{1 \times 8 \times 4 \times 1} = 4,500$
E5	10″	3¼″	25	No. 2½	1,430	$\frac{15000 \times 7 \times 13 \times .1}{1 \times 8 \times 4 \times 1} = 4,200$
G1	26.8″	4½″	67	No. 2½	1,100	$\frac{10000 \times 6 \times 9 \times .11}{1 \times 5 \times 2 \times 1} = 6,000$
N6	6″	4½″	15	No. 2½	1,100	$\frac{10000 \times 6 \times 9 \times .075}{1 \times 5 \times 2} = 4,300$
N7	26½″	2½″	106	No. 4	265	$\frac{45000 \times 3 \times 5 \times .12}{1 \times 4 \times 2 \times 1} = 900$
N8	7½″	2⅞″	30	No. 4	265	$\frac{5000 \times 3 \times 30 \times .1}{1 \times 4 \times 8 \times 1} = 1,200$

By this arrangement, motor, clutches, brakes, etc., and all quick running gearing, etc., may be placed in convenient, roomy machinery housing, located beneath sidewalk and always accessible by means of stairway. This arrangement also bends itself to a simple arrangement of control levers. One main lever operates both main friction clutch and brake. Starting-box for motor is located in pilot house convenient to operator. Further general arrangement may most easily be seen from drawings. (I am later giving notes on the designs and reasons for different details).

GEARING:—To get the desired strength it was decided to have all gearing of steel.

The diameters of gears were chosen with a view to reducing the heavy strain as soon as possible, and to give brakes, pulleys, clutch, etc., the most desirable speeds. In most cases, however, sizes were practically determined by allowable space.

In a table is given some of the calculations regarding the strength of the gearing. In one column may be seen the

While my experience has always shown the Lewis formulæ to give very consistent results, yet, very often, for gearing calculations, I consider, that no one formulæ should be rigidly adhered to. The gears chosen do not appear to be entirely consistent with calculations given on page 20. However, the weakest gear figures out to have a working strength equivalent to a torque arising from a 75 per cent. overload on motor.

In designing the gearing attention was first given to rack and main pinion.

The old cast iron racks were discarded for steel ones, and fourteen-tooth steel pinions flanged at one end, were dedecided upon. The old pitch was retained, as this enabled the rack segments to have the same spacing, and allowed of the old foundation bolts being used. Space did not allow of the racks being more than 5 inches wide (without cutting concrete), but pinions were made one inch wider than racks.

(Note.—Some judgment should be used as to when a pinion should be made wider than the gear. If the centre of a pinion becomes worn down and the pinion afterwards shifts sideways the whole strain may be thrown on the end corner of the weak pinion tooth. In the case referred to the flange supports, one end of the pinion teeth, and the teeth are very short in comparison to the pitch. Also the extensions on pinion teeth are shampered off and are sufficient to act something like another flange. (The shape of rack teeth enable them to take care of themselves fairly well). In bolting together a rack, made up of a number of segments, great care should be taken to maintain the correct pitch at the joints).

A fourteen-tooth pinion was used to obtain a fairly good tooth shape and to give as much wearing surface as possible.

In arriving at dimensions of gear teeth attention was paid to the following points:—Calculated strength, chances of abuse, rigidity of bearings and alignment, (for slow running gearing under bad conditions, narrow, coarse teeth are preferable and extra strains must be allowed for) wear, strain and jar on bearings, speed, effect of break in particular gear, cost, vibration, noise, whether gear is to have cut or cast teeth, nature of material, etc.

A bevel gear is assured to have a strength equal to that of a spur gear, having the same average diameter and the same average pitch. (This makes a considerable allowance for lack of efficiency in the bevel gear). (It is generally good practice to keep the force of a bevel gear less than three times the average pitch and less than one-third the distance from the pitch circle to the common dead-point).

(Note.—In designing a chain of gearing it is very common practice to make the heavy gearing according to the calculations and then to make the smaller gearing somewhat stronger. It may appear strange to give the most important part the lowest factor of safety. But, if momentum enters into the calculation, (such as due to the weight of a heavy swing bridge), a break in a small gear is very liable to make a jam and to so cause a break in the main gearing. As the smaller gears may usually be made a little extra strong, practically without extra cost or weight, and as all tooth strengths will be differently affected by wear, and as the weaker teeth may be liable to abuse, it is well to remove the chance of trouble occurring through a defect in one of a number of small parts).

(Note.—There is usually little difficulty with regard to allowing for wear on intermediate gearing. But high speed pinions are liable to "cut" or "hammer" and have a large power to transmit in proportion to their wearing area. And large main pinions usually have a tremendous unit stress to contend with).

Making the motor pinion of a large diameter not only reduces wear and strain on teeth, but also considerably relieves motor bearing, care was then taken throughout to have the number of teeth, in the gear wheels of each pair, not devisable by common factors. (This is liable to cause excessive wear in slow running gears, and hammering and vibrations in fast gearing).

In arriving at the sizes of gears for the swing bridge the above practical points were carefully taken into account and the formulæ calculations for strengths checked out and modified by different practical rules and by direct calculation.

Shafting:—The sizes of shafts were obtained from practical consideration and from direct calculation, using formulæ S = 321,000 H/ nd. Results were then checked by the use of tables on shafting and from practical winding machine data at hand.

Attention was given to the fact that shafting has to reverse and a factor of safety of about 9 was used. (This factor is based on 15 horse-power). Allowances were made for parts weakened by threads, etc.

The break and clutch shaft was made extra heavy to reduce the strain on the keys and feathers. As this shaft is short an increase in diameter is not expensive. When using the brake this shaft has to act against the momentum of the motor as well as that of the bridge.

Any small torsional spring in the longer lengths of shafting would be rather an advantage, so no attempt was made to eliminate torsional spring.

Brakes:—On account of the occasional high winds, and on account of an obstruction which would be dangerous to bridge, should it be allowed to overrun more than ten feet, it was decided to provide an extra brake. To guard against carelessness on the part of bridge operator or a possible break, or a lack of adjustment in working brake control, this brake is designed to act automatically should the bridge overrun its catch more than one foot. It may also be caused to act, at any time, by pressing a releasing lever with the foot.

A leather band brake, was chosen as being the most substantial and reliable when placed where there is good protection from the weather.

As the brake should have equal power when brake-pulley is revolving in either direction, and as it is very important that brake should not have excessive power under certain conditions, it was necessary to avoid anything in the nature of a differential-brake motion.

The brake band is designed so as to be conveniently adjusted, and so that it will stay in adjustment. The operating casting is very carefully designed. The centres are arranged so that, in the "off position" the brake-band springs entirely clear of the brake pulley, and so that the same force on the operating lever gives the brake the same power, in either direction. It will be noticed, that while the design shows great power, yet there is no possibility of the brake band "clinging," and so endangering the gearing.

In calculating for the size of brake it was assumed that the power which would start the bridge swinging under all conditions, would be more than sufficient to stop the motion. All friction, and particularly the friction of the gearing, which requires the motor to have extra power, acts in favor of the brake.

After looking over power and strength of gearing calculations, it was decided to set each brake for a retarding torque about equal to the torque of a 8 horse-power motor, but to design all parts amply strong to allow of either brake being set to a considerably greater power.

A 10 horse-power brake would mean a friction resistance of 180 pounds on the rim of a 20-inch brake pulley.

On the basis of a coefficient of friction of 20 per cent. this would mean a total pressure of 900 pounds. As area of an area of contact is 230 square inches, this means about 4 pounds per square inch pressure on leather. (This low pressure at a speed of 270 revolutions per minute would give great durability).

A pressure of 4 pounds per square inch gives a strain on brake band of $4 \times 20 \times 5 = 400$ pounds.

To this must be added the retarding torque strain of 180 pounds, making strain on the tight end of brake band equal to 580 pounds.

The force required to operate brake was found by adding the torque due to the 580 pounds acting on one brake-band attachment to that due to the 400 pounds acting upon the other.

The strength of brake-band, end-forgings, and the number of rivets used, etc., were made to amply cover requirements as shown by above calculations.

All sizes were carefully checked out by practical knowledge.

Friction Clutch:—On account of the very varied conditions under which the bridge must be swung, and on account of the great inertia of bridge, and the necessarily limited strength of gearing and pivot, considerable attention was paid to the design of the driving friction clutch.

A clutch is required that may be allowed to slip all the time without injury. It must not be uncertain in its action or liable to grip too suddenly. It must be able to drive in either direction.

The clutch designed is fully described in the drawing. It consists of a set of steel discs attached to an inner casting, which act against a set of cast-iron discs, attached to an outer shell—all incased, and running in oil. All parts are turned where possible and properly balanced.

While keeping the clutch shaft down to a moderate speed (170 revolutions per minute) necessitates the using of a rather large clutch, yet it does away with excessive "cutting" and "balancing" difficulties, and gives smoother and more certain action when machinery is being put in motion.

The clutch is designed to have a normal maximum of 10 horse-power.

This is equivalent to a pull of 225 pounds at average diameter of friction discs, or to 21 pounds frictional pull for each pair of faces.

The surfaces in contact are turned cast-iron and rolled steel plate. After looking into condition of lubrication, etc., and comparing with previous experience, it was decided that a coefficient of friction of .07 would be about a fair working value to assume.

This would be equivalent to a pressure of 300 pounds between discs.

Adding to this the strength of the releasing spring and the friction of moving one section of clutch (weighing 270 lbs.) along shaft, would give a total pressure on thrust bearing of about 550 pounds.

Twenty-four small springs are used against end cast-iron disc, so that no jam or undue strain can be caused by friction discs being thicker at some places than at others. These springs also limit the power of clutch.

Special attention was given to feathers, etc., and all parts were designed strong enough to withstand extra heavy strains. The operating arrangement used neutralizes the friction of the thrust bearings, and simply relieves shaft of portion of weight of clutch.

Equalizing Gear:—As two main drive pinions are arranged for, driven from the same motor, it was necessary to provide an equalizing gear drive. If the two pinions were connected by rigid shafting, the inequalities in the gearing would often cause one gear to act directly against the other gear. Then any slight change in position of centre of bridge would probably cause a jam and a break.

In the design the rim of the main gear is made separate from the main casting. This enables true holes to be bored for the pins about which the two idle pinions revolve. All teeth are cut. While great care is called for in placing the bevel gearing, so that the gears and pinions will react upon one another, yet care was taken to design each idle pinion sufficiently strong to enable it to take care of all the strain.

Main Bearings:—In designing the main bearings and brackets every precaution was taken to place strains on those parts of turntable best constructed to withstand them. At the same time care was taken to have as few separate parts attached to the bridge as possible.

Parts were all designed to facilitate attachment without interfering with the operation of the bridge. The main bearings were designed so that they could be set in exact position an' then packed out, permanently by running a special babbett metal in behind them.

Bearings Attached to Support for Motor:—It is necessary, for good running, that the motor gears should always be kept in as correct alignment as possible—no spring in bridge or supports should be able to affect their relative position. For this reason the two gear shaft bearings are made in one casting and are bolted directly under motor support, thus practically forming part of solid motor-frame casting.

The next bearing on this shaft (clutch brake shaft) is kept some distance from these bearings and is also supported from main bridge girders—thus reducing any relative spring to a minimum, and also reducing the affect of any such spring.

It was necessary to limit the size of the supporting I-beams, as space would not allow gears to be used having a greater distance between centres.

Bracket:—The bracket shown in this drawing is a heavy cast-iron bracket for supporting equalizing shaft and brake shaft. It follows out the general idea of keeping bearings for each pair of gears practically in one casting.

This bracket is bolted to main girders. It will be noted that the equalizing shaft is kept as close as possible to the base of this bracket.

Provision is also made for supporting operating mechanism, for brakes, from this casting. Thus reducing the fitting to be done at bridge.

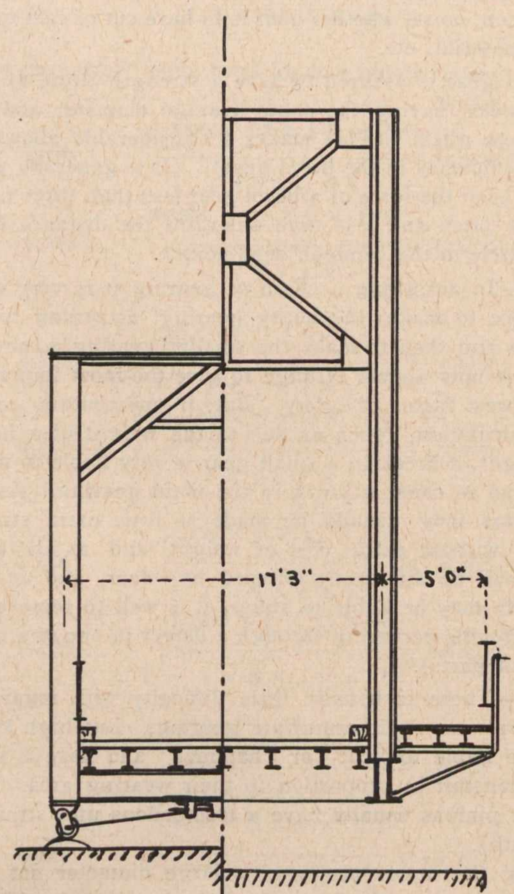
Bracket and Expansion Coupling:—A little side play has usually very little affect where spur gears are used, but bevel gears should be kept closely to their correct position.

By using the expansion clutch, each of the end bevel gears on equalizing shaft may be separately set, and no expansion or contraction of the long equalizing shaft can affect their adjustment.

The detailed drawing shows how each end of equalizing shaft is held from play, in either direction, by the bevel pinion "E 6" and the collar "E 4."

Details of Automatic Brake:—The emergency brake itself has already been commented on.

This brake is operated by the trip casting being moved, thus allowing the spring to act on the brake lever.



End View. Section at Centre.

The trip casting may, at any time, be moved by the operator's foot, through the medium of a chain attached to the weighted end of trip casting. The trip casting may also be independently operated by the cam being rotated in either direction. (It will be noted that, if brake is put on by the operator, no trouble can follow through the automatic device afterwards attempting to do the same thing before motion of bridge is checked).

The automatic cam is operated by a nut travelling along one section of the equalizing shaft.

The short threaded shaft is held from end motion by the equalizing gear bearings. The device is entirely adjustable for either end of bridge swing and the motion is timed to act with the required accuracy. No break in automatic mechanism can be caused through swing failing to be controlled by this brake.

The operator can at any time readily release, and reset, this brake, by pulling upon a conveniently placed chain attached to the end of brake lever.

The brake mechanism is designed to give the pressure arrived at in a previous calculation.

(Note on automatic stop motions.—Had it been required to have automatic stop bridge at an exact point, the mechanism would have been worked out on different lines).

To do this mechanically all motions would have been caused by quick-acting cams controlled by a travelling screw motion. The first motion would allow the brake to be regulated by a centrifugal governor. This would allow bridge to approach spring bumper catch at a certain fixed slow speed. Just before striking bumper, the automatic would put on the full force of the brake.

A solenoid brake controlled by contact points at end of bridge is another effective method of automatically stopping the motion.

Some bridges are slowed up by friction at their ends. It is not considered advisable to put too much resistance at end of bridge as turntable may be endangered.

END-LIFT AUTOMATIC DRIVE:—After bridge is swung to the closed position it is necessary to raise the ends to a certain level in order to place the proper strains upon the end abutments.

This is done by means of heavy rollers, toggle mechanism, and nut-driven from a shaft, running the entire length of bridge, by means of bevel gearing.

The main screwed shaft is directly geared to the above-mentioned long shaft. The mechanism shown is designed to give the toggle drive shafting the required number of turns, when the operator throws in the friction clutch, and then to stop the motion automatically.

The friction clutch is of ordinary standard design. While the size indicated is amply strong to give the required pressure on abutments, yet it is chosen of such a size that it cannot damage bridge or break any gearing, (speed of this clutch is 100 revolutions per minute).

The operation of the automatic drive is as follows:—

When bridge has been closed operator throws in friction clutch lever. This starts the toggle-motion shafting. When the shafting has made the required number of revolutions the nut "J 3" strikes the end casting "J 2" and causes the dog casting "J 6" to be drawn out of contact with the dog "J 8." The dog "J 10" cannot drive because its driving faces are set wrong way. This operation occupies twenty seconds, any time after which the operator may release the friction clutch.

With this mechanism it is impossible for the operator to put any strain on end lifts when motor is travelling in wrong direction. It also differs from motions in common use, in that it requires but one operating lever.

This combination of automatic stop and friction clutch, meets very fully the difficulties arising from droop of bridge during a very hot day.

BRACKETS AND GEARS:—This sheet details some of the gearing, etc., in connection with the end-lift drive. A vertical shaft is shown which provides for a hand-drive. It will be noticed that the main bracket shown, is made to span two floor stringers, thus doing away with possibility of twist.

COST OF I.C.R. ROLLING STOCK.

160 60,000 lbs. box cars at $990 each	$158,400 00
130 30,000 lbs hoppers at $562 each	73,060 00
5 60,000 lbs. refrigerators at $1,590	7,950 00
100 80,000 lbs. flats at $878	87,800 00
9 60,000 lbs. stock at $900	8,100 00
8 Conductors' vans at $1,640	13,120 00
1 dining car	20,587 50
1 sleeping car	19,500 00
2 express cars at $7,000 each	14,000 00
2 postal cars at $8,675	17,350 00
4 locomotives valued at $19,500 each	78,000 00

TO CLEAN COPPER AND BRASS.

Very finely powdered bath brick rubbed on with a piece of lemon will remove all stain and tarnish from articles of copper and brass; they should be rubbed over with a clean, dry cloth, then polished with a soft cloth or leather.

RAIL FASTENINGS AND TIES.

Andrew F. Macallum, C.E., Consulting Engineer, Toronto, Ont.

Rail Fastenings.

In Canada and the United States the standard fastening has practically been the plain hook-headed spike of square cross-section, being 9/16-inch square and from 5 to 5½ inches long under the back of the head, the shorter spike being used for hard wood like oak. But it has been felt by engineers for some time that this form of fastening is wasteful and far from efficient, so that at present one or two roads, notably the Illinois Central, are using as standard a screw spike. The spike does not hold with sufficient firmness to prevent undulations and creeping of the rail, which result in a more or less rapid wearing out of the tie, especially of soft wood. In the second place the driving of the spike in soft wood the fibres are broken to a great extent, and as a result does not stand against the lateral pressure of the rail and the consequence is that the spike-hole is increased so that the spike no longer holds. This necessitates the spike being re-driven and this constant re-spiking rapidly ruins the tie long before its normal life. It appears then as the spike does not hold the rail firmly to the tie that the tie is then worn out more rapidly than it should be.

Of various devices to overcome this, the best so far seems to be the screw spike as used upon different European roads. Not only does it prevent much of the mechanical injury to the tie in being placed, but it holds the tie so firmly that much of the wear is done away with. Combined with a tie plate this saving action is reduced to a minimum.

A test has recently been made at the Purdue University of the comparative pulling strengths of common spikes and screw spikes with a holder having a grip similar to that given by a rail. The average force in pounds was found to be as follows:

Kind of wood.	Force required to pull spike. Screw spike.	Common spike.
Chesnut	9,418	2,980
Oak	11,240	4,342
Pine (long leaf)	10,558	2,296
White oak	13,026	6,950
Pine (loblolly)	8,504	3,474
Cedar (white)	3,415	1,140

Tests were also made to determine the effect of a side blow, such as would come on a rail in service. A 500 pound weight was dropped against the side of the rail head and a drop of three inches was given. One blow of this weight delivered to the side of the rail head, fastened with two common spikes, pulled the inside spike out ½ inch. This spike, which had been started half an inch, was then pulled out, requiring a force of 3,250 pounds, while the outside spike required a force of 4,870 pounds.

On the other hand seven blows of the weight on the screw spike did not preceptibly start the spike, but gradually bent the head of it over until the rail pulled out. The outside spike was slightly bent. In ordinary track work where long stretches of track are to be put down a machine is used, but for short distances an ordinary key like an augur is used. With a machine it has been found that two screw spikes could be put in while three spikes were being driven. In this country the principal objection to the use of screw spikes is the matter of boring holes which cannot be done in the same manner as in Europe where they are done at the plant that treats the ties, on account of the different rail sections used.

Tie Plates.

The functions of the tie plate are two-fold—to distribute the load from the rail to the tie and to prevent the mechanical abrasion of the tie as much as possible. With rails having a narrow base the rails cut into the ties badly, but in increasing the middle of the base in recent years tie plates on timbers like white oak are no longer necessary. Most recently designed plates made with the idea of being anchored to the tie so as to prevent the communication of the motion of the rail to the plate. As a result we have a large number of different forms of plates provided with prongs, spines or flanges on the bottom which are pressed into the tie either by the weight of the passing load or before the rail is laid. The chief objection that is made to plates at the present time, particularly in connection with the use of softer woods is that not only do they not aid in preventing the wear of the fibres but that they actually assist the rail to wear. Flat plates are used on some roads, but it is claimed that with them it is very difficult to keep a track in gauge. The Southern Pacific Railway have used a flat plate since 1892, and claim that these plates have given excellent service. The Pennsylvania have recently also adopted the plate having no prongs or cutting edges to the tie plates, following the experience of the European roads in this matter, which invariably use rigid flat plates with firm fastenings.

Some European roads use a creosoted wooden plate about one-eighth inch in thickness and eight or nine inches long corresponding practically to the shin used in this country. It has been found that this wooden tie plate adheres so closely to the tie that they practically act as one and the wear is practically at the expense of the tie plate. In this country the Santa Fee have already used this form, having these plates a little wider than the rail and fastened to the tie with several small nails. These plates are about one-quarter inch in thickness, of oak, and about eight inches in length.

Ties.

The usual tie yet used in this country is the timber tie, principally because of its cheapness in comparison with a composite tie described later. The tremendous number of ties, however, annually consumed in tracks is rapidly depleting the forests of the country, and yearly increasing the cost of the ties. The timber most generally used in this country for ties are oak, cedar, hemlock, pine, tamarack, and in some places spruce.

In most of the specifications for ties it is usually stated that all ties must be made out of "live" timber. There is no reason why timber that has blown down or is dead should not be used for ties so long as they are sound, and especially if they are to be treated. As a matter of fact all heartwood of trees is dead wood in the sense that it is no longer alive. A better specification would be as follows: "That all ties should be made from straight sound timber free from heart or ring shakes, decay, excessive knots, worm holes and red heart."

In this country the average life of hemlock is about five years, of oak and pine eight years, and of cedar varying largely upon location and use of tie plates.

To effect economy in cutting ties the Great Northern Railway tried the use of triangular ties, when four could be cut from a large section of timber and two from a small, instead of two and one respectively, but not with success as rings breaking off make this a dangerous form of tie, especially if the spikes are not driven directly in the centre. The rectangular tie is yet the best form outside of the pole tie, which is not an economical one with respect to timber wasted. The half-round tie is advantageous from a mechanical standpoint, giving a greater bearing surface per mile of track with the usual spacing.

Owing to the difficulty of keeping track of ties in the track it is almost impossible to give approximate figures even as to the effect upon their life, not including the ties that are spike killed. Hard ties, like oak, when laid in stone ballast are hammered by the rail and the soft ties, like cedar, are cut by the rail, so that the life of each kind is shortened in this kind of ballast. Cinder ballast also has the same effect, but not to so great an extent. Ties should be laid with heart side down if made from large timber, as otherwise the action of the sun will open the rings of the timber and thus hold water which hastens decay. Ties that are very crooked should not be used at all, for they cannot be properly tamped. A tie with a curve in it should not be put in the track having this curvature either up, when it spoils the appearance of the track, or down, as it will pocket out a hole in the ballast that will ultimately form a receptacle for water to collect in.

The usual length for ties is eight feet, with the other dimensions eight inches by seven inches, the extra inch in thickness being added for the heavier rolling stock now in use, but it is not advisable to increase this thickness, as it would interfere with the proper use of the tamping bar. Less than six inches in thickness the ties are not stiff enough for the present rolling stock and will probably split with spike driving.

The increasing cost of wooden ties, together with the decreasing supply, have caused railway managements to look for other material to take the place of wood.

Wood is treated by various preservative processes to lengthen its life, as, for instance, creosote and zinc chloride, which nearly doubles the present cost of the tie. That these processes may get their full value ties should have tie plates and dowels, also for the soft woods, for the reason that the rail wears and cuts the tie long before its normal life. It is then poor economy to treat these soft wood ties unless they are to be protected from rail cutting and spike killing. The treatment of ties has been carried on in this country so far to a very limited extent on account of the expense of treatment not justifying the cost. It will develop, however, as the price of the raw tie goes up, and we may expect to see some of the different forms of treatment now on the market being used extensively within the next few years. So far creosote is the most effective of the timber treating processes and is used almost exclusively in Europe. But in this country other processes like zine chloride are chiefly used because of their relative cheapness. The creosote injected averages about ten pounds per tie for pine and about four pounds for an oak tie. This treatment of the tie adds considerably to its weight, the treated tie weighing about 200 pounds or more. One objection to the chloride treatment is, that if the ties are placed in a wet place or where the rain fall even is excessive the metallic salts are leached out being soluble, thus removing the preserving element. After treatment ties should be loosely piled and thoroughly seasoned before they are put in the tract, and this should be done with ties of any kind of timber and treated by any process.

Concrete and Steel Ties.

The use of concrete and steel ties as substitutes for wooden ties is yet in its infancy, although tests over sections of tracts have been tried. Enough has been done to show that both concrete ties and steel ties can be made that will successfully stand the heaviest traffic, but their durability and ultimate economy remain yet to be proven even approximately.

Concrete ties cost about 42 cents a piece, but are excessively heavy, weighing about four hundred and fifty pounds a piece. They are consequently difficult to handle, and, being also brittle have been used only to a very limited extent. Ties of concrete reinforced with steel like old rails have been used on one or two roads with fair success, but so far no road has seriously taken up any of these concrete or concrete steel ties.

Steel ties have been used more extensively, but are yet in an experimental stage in this country. Practically the design of steel ties has followed either the eye beam section, or the inverted trough section. The Carnegie steel tie is eight feet six inches long and weighs 19.36 pounds per foot. Near each end the bottom flange is bent down to form a lug to prevent lateral movement in the ballast. The rail is fastened to this tie by means of ¾-inch bolts with heads formed to fit the sloping under surface of the top flange and on these are slipped rolled steel clips which are secured by bolts and spring washers. The total weight of tie and fastening is about 170 pounds.

The Snyder steel tie consists of a steel rolled into the form of a trough 7 inches square and filled with asphalt at a temperature of 240 F. The tie is laid open side down, so that the ballast works up into the asphalt which assists in holding the tie in place in the roadbed. The rails are held to the tie by means of clips and bolts which are inserted into the tie through slotted holes.

In looking over most of these trough shaped ties it is evident that the rolling mill and the railroad men have been long under the impression that they could get along with a minimum amount of metal, but gradually they have realized the necessity of the greater weight and the ties have increased in weight from 65 pounds to 165 pounds, while the length has increased to eight feet ten inches. Speaking of length of ties it is to be noted that the American Maintenance of Way Association have recommended that the length of ties be increased to eight feet six inches. Inspection has shown that the rails and clips in the course of but five years' service have worn into these metal ties, and that they were no more serviceable than wooden ones.

The Carnegie tie, described before, is too stiff and rigid and gives a hard running track, due to its narrow supporting face, and also lacks holding power in the ballast. The trough ties have been found hard to tamp and keep the track in surface, especially when low sections of track require to be raised, while all forms of metal ties are more or less noisy compared with wood.

Composite Tie.

The French Railways have developed a combination tie of wood blocks combined with channel iron that seems to meet the requirements better than the steel tie. This form of tie is now being introduced into this country and can be made at a cost of one dollar and a half. This form of tie is shown in Plate——, having one side with rail fastened with spikes and the other rail inclined and fastened with screw bolts in the usual European method. The Michel tie shown is composed of the channel iron skeleton, having symmetrical blocks of wood solidly fastened at the ends and leaving an empty space between. These metallic sections are fastened to the blocks at each end with four cross straps, which are pressed tightly over the flanges at the channel irons. Their object is to hold together these iron walls and to thus insure the wedging of the blocks in the interior of this envelope. The rail should be fastened to the blocks with the intermediary of a plate with shoulders by screw spikes and on curves cut into the block as shown in illustration to prevent track spreading. The total weight of this tie is about one hundred and seventy-one pounds. The blocks are 27.5 inches long, a length that was recognized as sufficient to assure the bed of the cross tie on the ballast. This form of tie was found to give the best results under the mechanical tests.

In considering all this, however, it really comes to the commercial value of the tie, and it may be put concisely as follows, taking oak ties as the standard.

When oak ties reach a cost of ninety cents each delivered in the railway it will be economical to treat ties of inferior wood with zinc tannin, or by using improved fastenings on a concrete tie costing one dollar and a half if it will last twenty years.

With steel ties costing one dollar and seventy-five cents each delivered it will be necessary to obtain a life of twenty-eight and a half years to be as economical as white oak ties costing seventy cents delivered.

In order to make them as economical as white oak ties costing seventy cents delivered we can pay only one dollar and fifteen cents for concrete or steel ties delivered if they will last twenty years, and upon this length of life we yet have no reliable data.

Spacing of Ties.

The spacing of ties in track has varied on different roads under different conditions, but taking the locomotive loads the following spacing of ties is suggested:

Maximum axle load. In tons.	Weight of rail. Pounds per yd.	Number of ties. Recommended.
30	85	17
22	65	19
18	56	20

The above is for a thirty-three foot rail, and the greatest number of ties given is the greatest possible number that that will allow of proper tamping, and the use of the shovel properly between the ties. Within this limit of spacing the greater the number of ties the better support against deflection and permanent settlement, less cutting of ties, better alignment and a better gauge on curves, regardless of the weight of the rail used. In fact upon loads of light traffic or upon electric railroads it is better economy to space the ties closer and use say a sixty-pound rail than to widen the spacing and use an eighty-pound rail. It will effect a saving of about two thousand dollars per mile and giving a track little less in stiffness. No effective reason can be given for the heavier rail in cases like the above, although the tendency of electric railroads in following that of steam roads is to use eighty pound rails. At rail joints it is generally the practice to place the ties closer together, in fact too close, in many cases interfering with the proper tamping of the ties. In the case of a suspended joint it is considered good practice to place the two joint ties about eight inches apart in the clear, but the next two ties should not be placed so close as to interfere with the use of the shovel. In supported joints it is common practice to place the two shoulder ties as close to the joint ties as possible consistent with the proper use of tamping tools. Only three ties, however, should be so closed up, as otherwise the extra bearing surface is more than compensated for by the inconvenience in removing ballast in raising or removing ties.

In practice there are two joints used, namely, the supported and the suspended. In the former case the junction of the rails is on a tie, and in the latter case between ties. There are many advocates of either of these methods, so that it may be assumed that any advantage one way or the other is very small so far as support is concerned. In American practice the suspended joint is generally used, especially where the short splices are used, probably for the reason that it is practical to slot spike two ties to prevent rail creeping, where in the other case a long splice is require to extend over three ties. If there is any creeping of the rails the joint and shoulder ties on one side are crowded together and pulled apart on the other, and it often happens that in moving back ties to place that joints that were originally supported become suspended. Possibly too much time and trouble are given to spacing of ties about the joints for the creeping of rails in track practically makes it impossible to maintain a special arrangement of joint and shoulder ties without constant respacing and adjusting that has only the effect of more or less spoiling the conditions of the track.

Besides the two methods of laying the joints there are also two methods of location with relation to each other. One method is to have the joints square or on the same tie or space and the other is to break or stagger the joints, that is to have the joints on one rail of the track opposite the middle of the parallel rail. If it is intended to keep the track in first-class condition, as on main lines, then the alternate joint is generally used at the present day. It gives a greater continuity of strength to the track for the reason that there is always a solid rail opposite each joint, and the track is easier to keep in first-class condition, except where the road has been allowed to get into a bad state of repair, thus giving the cars a swaying motion. The square joint method is going out of practice rapidly even upon branch lines, although in places where the track heaves badly in winter the square joint is preferable.

SWEDISH LOCKOUTS.

During 1907 there occurred 298 labor conflicts, embracing 21,654 laborers, with a total loss of 531,000 working days. The corresponding figures for 1906 were 277 strikes, 18,612 strikers, and 483,500 working hours lost. The weapon of the employers, the lockout, commenced to be used more commonly during 1907. Not less than twenty-four labor conflicts had their origin in a lockout, while the corresponding figure for 1906 was seven. On account of this mode of proceeding, the employers have also more frequently than before succeeded in getting their conditions accepted. Of the other labor conflicts, 237 had their origin in strikes.

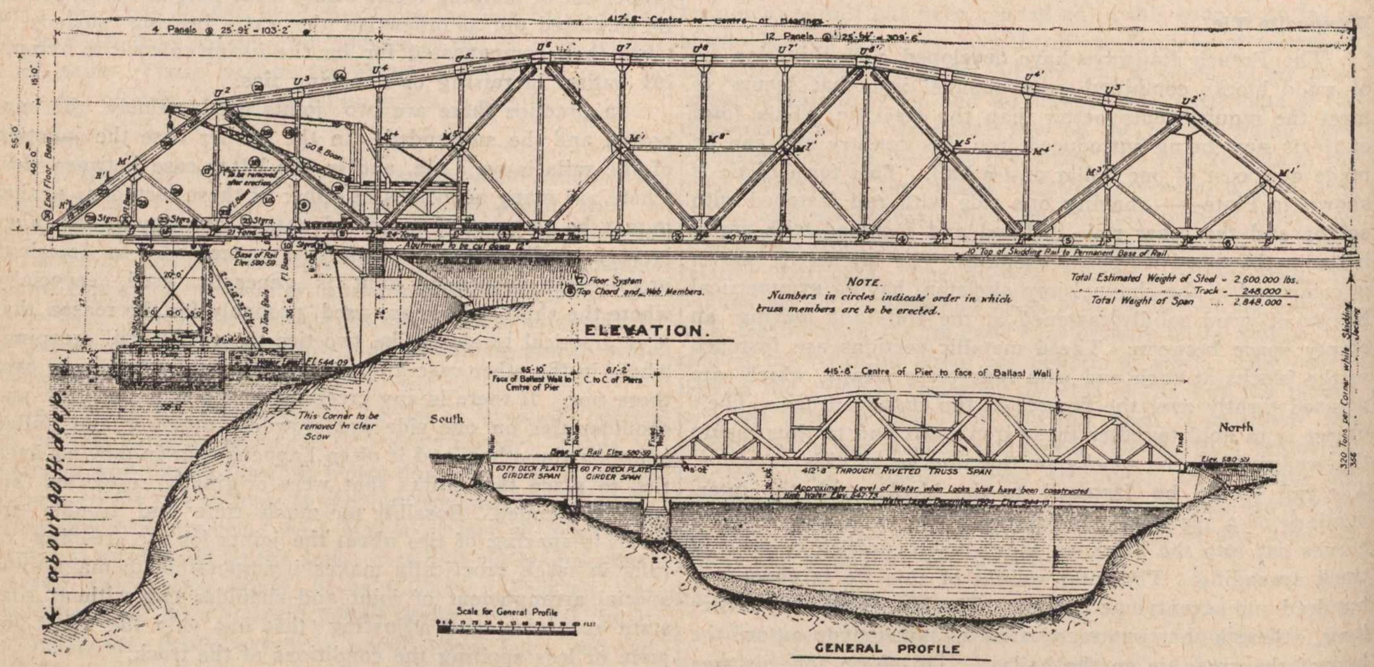
ERECTION OF FRENCH RIVER BRIDGE—CANADIAN PACIFIC RAILWAY.*

By C. N. Monsarrat, M. Can. Soc. C.E.

The new branch line of the Canadian Pacific Railway, extending from Romford, Ont., a point about six miles east of Sudbury, on that Company's main Transcontinental line, southerly to Bolton Junction, where it connects with the Owen Sound section, about twenty-one miles north of Toronto, includes a number of important bridges, one of the largest of which is that crossing the French River, about forty-three miles south of Romford.

This bridge is located at a point where the river has a width of approximately 550 ft., while the depth of the water for about three-fifths of the crossing averages 90 ft. The character of the bottom is rock, with about 10 ft. of soft mud overlying it. The current is, however, very slight, being only about 3-10 of a mile per hour.

In order to avoid the great expense of building a pier in the deep water, it was found necessary to locate the first pier 415 ft. south of the north abutment, where a good foundation was obtained in about 48 ft. of water. The dimensions of this pier are 9 ft. x 30 ft. at the top under the coping, which is 2 ft. thick, with an overhang of 4½ in. on all sides, and has a batter of 1 in 12 on each side for a depth of 30 ft., making the bottom of the shaft on the footing 14 ft. x 30 ft., the ends being vertical. The foundation, or footing, is 21 ft. x 33 ft. 10 in. long by 40 ft. high; the total height of the pier is 72 ft., and it was designed to resist the tractive forces from the spans supported by it. There is a second and smaller pier located 67 ft. 2 in. farther south in about 15 feet of water, the shaft of which has a batter on each side of 1 in 24; the total height of this pier is 44 ft., and the dimensions at the top are 6 ft. x 16 ft. under the bridge seat, or coping, which overhangs 3 in. on all sides. The abutments at both ends are located at the water's edge. The north abutment could not be built farther south on account of the rock at this point, which is very steep on the west side.



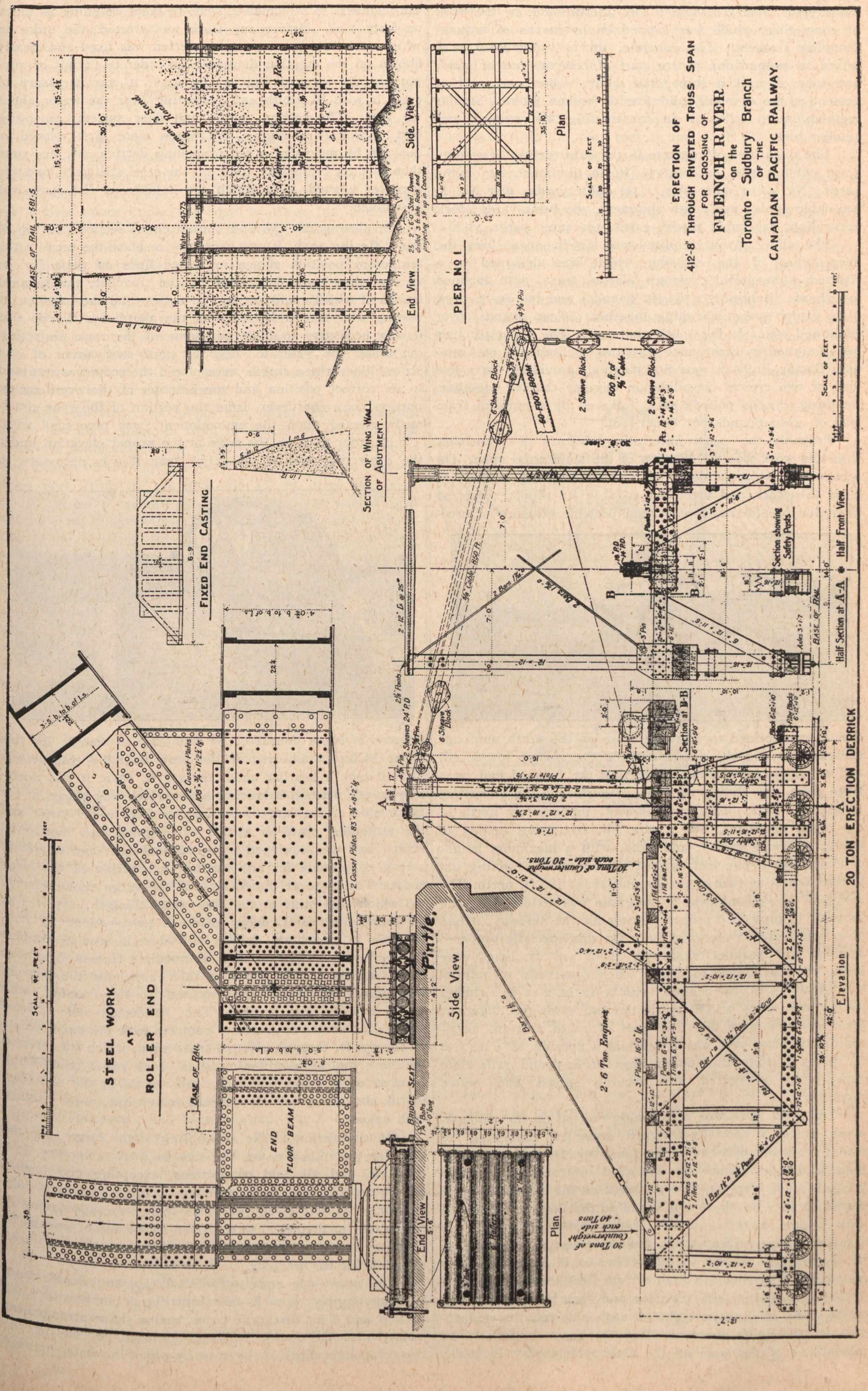
In laying out the substructure three independent triangulations were made. Reference points were located on the tops of the hills on either side of the river, on three parallel lines, one along the centre line, and one at each end of the piers; these points were high enough to permit of an instrument being set up on one side and a foresight being taken on the opposite shore at any time during the progress of the work.

After the abutments and piers were located, they were checked by steel tape rigged as follows: A ring bolt was set in the rock at the north shore of the river directly on the centre line of the bridge, and from this a ⅛-in. steel cable was stretched across to the south shore and made taut by block and tackle. To prevent sagging of the cable, floats, having their tops at exactly the same level as the ring bolt, were anchored in the river at frequent intervals to support it. Rings were attached to this cable every four feet and a 600-ft. steel tape passed through them.

The difficulties encountered in getting plant and material for the substructure to the site were exceptionally arduous. Everything had to be brought in from French River village on Georgian Bay, at the mouth of the French River. First, rapids had to be overcome, then a portage of a mile and a half, then the plant was again floated up the Pickerel River (which had its difficulties, too), a distance of twenty-three miles to what is called the Horse Shoe Falls. There the outfit was elevated some twenty-five feet, loaded again and transported some twelve miles over a swift and rough course to the bridge site.

Broken stone and sand used in making the concrete were hauled a distance of twelve or fifteen miles through a wilderness by teams in winter The contractor's plant consisted of the usual concrete outfit of picks, shovels, concrete mixer, blacksmithing outfit, and other things incidental thereto; one submarine drill, complete, for preparing the foundations; several sets of drill steel, averaging forty-five feet in length, one 30-ft high steel frame with sliding carriage for drill, truck wheels, and operating platform. This outfit was operated by hydraulic pressure furnished by a large Worthington high-pressure pump, having the necessary attachments and connections; two 30 horse-power boilers, two 32 horse-power hoisting engines, with derricks and swinging gear complete, one 1¼-yard orange peel bucket; two 20 horse-power hoisting engines with derricks; four large scows, 24 ft. x 60 ft., and two tugs; two sets of diving apparatus, in addition to many other odds and ends of machinery. The drilling machinery was placed on the scows, which were anchored at the pier sites. After holes were drilled, they were shot with dynamite, and the loose rock removed by means of the orange peel bucket, or a derrick with chains and grappling hooks at the bottom, until the foundation had been properly benched and levelled off. Holes were then drilled in the rock about four feet apart, and 2 in. diameter steel dowels, six feet long, set in them, and projecting about three feet up into the concrete footing. The timber caisson for pier No. 1 was built about forty-eight feet high and well reinforced with timber braces. Heavy canvas was attached around the bottom on the inside, and after the caisson was sunk into position, the divers went down and rolled this out. Concrete in sacks was then deposited around the edges to make it conform to the contour of the rock, and so prevent any wash or current through the pier. Mortar, of a consistency of one part of cement to two

* Paper read before the Canadian Society of Civil Engineers.

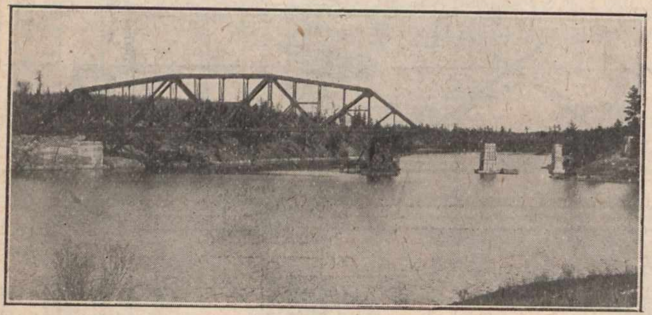

ERECTION OF
412'-8" THROUGH RIVETED TRUSS SPAN
FOR CROSSING OF
FRENCH RIVER
on the
Toronto - Sudbury Branch
OF THE
CANADIAN PACIFIC RAILWAY.
PIER No 1
End View
Side View
Plan
Scale of Feet
Section of Wing Wall of Abutment.
Fixed End Casting
Steel Work at Roller End
Scale of Feet
End Floor Beam
Bridge Seat
Pintle
Side View
End View
Plan
Base of Rail
20 Ton Erection Derrick
Elevation
Half Section at A-A
Half Front View.
Section showing Safety Posts
Section at B-B
Mast
60 Foot Boom
6 Sheave Block
2 Sheave Block
500 ft of 3/4" Cable
2-6 Ton Engines
10 Tons of Counterweight each side - 20 Tons.
20 Tons of Counterweight each side - 40 Tons

parts of sand, was then deposited to the amount of fifty cubic yards, followed without any intermission, by the work of concreting, which was carried on by means of bottom-dumping buckets. The concrete, up to water level, was mixed in proportions of one part of cement, two of sand, and four of broken stone, and above water one part of cement, three of sand, and five of broken stone. Similar methods were followed in constructing the second and smaller pier.

The quantities of concrete in the substructure aggregate 3,020 cubic yards, as follows: North abutment, 913 cubic yards; No. 1, or main pier, 1,421 cubic yards; pier No. 2, 226 cubic yards; and south abutment, 460 cubic yards; rock excavation, 337 cubic yards; earth, 141 cubic yards.

The above layout required one 415-ft. span, over the deepest part of the crossing, which was designed as a rivetted, subpanelled, through Warren truss, with inclined top chords (weighing 2,563,362 pounds) and two 60-ft. deck plate girder spans (weighing together 126,540 pounds) over shallowed water to the south abutment. The superstructure was designed in accordance with the requirements of Canadian Pacific Railway 1904 Specification, providing for a live load of two typical consolidation engines coupled together, weighing 337,000 pounds each, followed by a uniform train load of 4,000 pounds per lineal foot.

Probably the most interesting feature in connection with this work was the erection of the main truss span. On account of the great depth of water it was not possible to build falsework and erect the span in its proper place, so after due consideration of several possible schemes of erec-

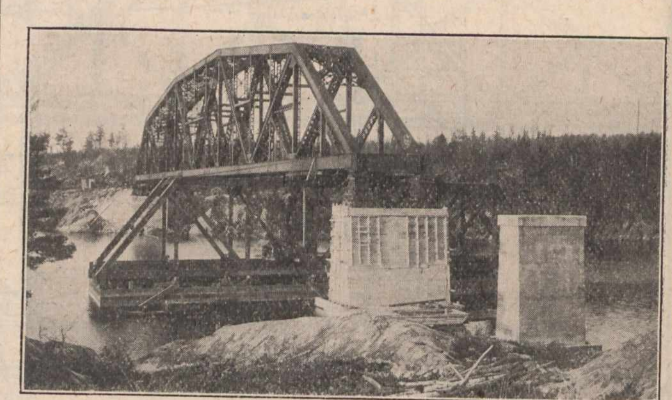


tion it was decided to erect the span on the north approach embankment, on the centre line of the bridge (produced) and launch it forward by supporting the forward end on a large scow, and sliding the rear, or north end, on a skidway of greased rails. This embankment, immediately north of the north abutment, was a new fill, consisting mainly of boulders, coarse gravel, and sand, with a maximum height of about twenty-five feet against the abutment, running out to the natural surface of the ground about 100 ft. north. The width of the embankment at subgrade was sixteen feet, and in order to provide a proper bearing for the skidway, it had to be widened to twenty-six feet. On this specially prepared roadbed two parallel skidways, about 316 ft. long, were built, ten feet centre to centre, each consisting of railway ties about 15 in. on centres, with a 12 in. x 12 in. timber 16 ft. long, every 10 ft., to tie the two skidways together. On these ties were laid five lines of 12 in. x 12 in. longitudinal timbers, over which was laid a flooring of 3 in. x 12 in. planks, supporting seven lines of 80-pound rails, laid with joints staggered, and securely spiked and bolted together.

The steel work was accordingly erected on the embankment, using a specially-designed traveller, consisting of two 60 ft. boom derricks of ten tons capacity each, mounted upon a timber framework designed to travel upon rails gauged 14 ft. centres, the platform of the traveller being placed 12 ft. 7 in. above top of rail so that lorry cars, loaded with bridge material, could readily pass underneath on standard gauge railway track, and the material be picked up by the traveller booms. Each of the 60 ft. boom derricks was handled by separate double-drum Beatty engines, placed at the rear end of the traveller and forming part of the twenty tons of counterweight on each side required to provide for the uplift due to loading the boom derricks. The assembling of the span on the embankment was, in itself, quite a difficult operation, on account of the large size of the members to be handled, some of them weighing as much as forty tons. Before any work was started, the order in which each member was to be erected was fixed and clearly shown on the erection diagram. In order to permit of supporting the forward end of the span, it was necessary to erect it with its south end projecting over the water about 103 feet. The bottom chords and floor system, excepting that portion overhanging the water, were first placed in position by means of a self-propelling derrick car, ties were then laid for temporary track on the steel stringers, and the traveller erected, with which the balance of the span was assembled.

In placing the two end bottom chord sections on top of the stiffening span, it was necessary to place the scow in the temporary position shown in dotted lines on plate No. 1, so that they could be placed by the traveller, the forward trucks of which could not be run out beyond the panel point resting over the bridge seat on the abutment. To do this it was necessary to blast out some of the rock projecting out under the water to clear the north-east corner of the scow. When these chords were placed the scow was returned to its correct position and the erection of the overhanging portion, as a cantilever, from the portion of the span previously erected upon the embankment, was proceeded with.

In order to place the scow at the proper elevation under the projecting end of the large span it was necessary to



depress it about four feet by pumping in water. As this water ballast would render the scow unstable transversely until it took a bearing under the 415 ft. span, it was necessary to use a small balancing scow, which was placed at the north side of the large scow and secured to the latter and the stiffening span by means of diagonal and horizontal struts, and was equipped with counterweight and adjusting screws to provide for any raising or lowering of the large scow. The general dimensions of the large scow referred to, which was built at the site, were: Length, 155 ft.; 33 ft. beam, and 12 ft. deep; made in two sections for convenience in launching. It was built of 12 in. x 12 in. timbers for the ends; bulkheads and intermediate frames, 6 in. x 12 in.; sheating on the sides, 4 in. x 12 in. for the bottom, with joints staggered and secured to the framing with ⅝ in. x 12 in. lag screws. The bulkheads were spaced 22 ft. 1 in. centre to centre to conform with the panel points of the 150 ft. through rivetted truss span, which was erected on the scow, as a stiffening span, each panel point being blocked on a cross bulkhead. All seams in the sheeting, up to about two feet above load water line, were caulked with oakum.

On completion of the assembling of the large span the traveller was taken down, the ties used as temporary floor removed, and all field connections, excepting end portals and sway bracing, were rivetted before launching was started. The field rivets, of which there were approximately 60,000, ⅞ in. diameter, were driven by means of pneumatic rivetting hammers, a compressed air plant having been installed for the purpose.

The scow was equipped with boiler and double-drum hoisting engine, as well as a centrifugal pump with 8 in. suction and 6 in. discharge pipes, and a sluice arrangement located over the double bulkhead forming the ends of the two component parts of the scow by which the water pumped in could be controlled, and directed into either half of the scow. Each intermediate bulkhead had an 8 in. x 8 in. hole near the bottom so as to equalize the water in each compartment.

The load from the south end of the 415 ft. span, and the 150 ft. stiffening truss supported by the scow, was about 1,000 tons. The load from the north end of the span, amounting to about 640 tons, was transmitted to the skidway through the two large fixed end cast iron shoes (used temporarily for the purpose), placed ten feet centre to centre, under the end floor beam, which had been designed with a special view to such use. This arrangement of the castings left a clear space under the truss bearings for landing of the span on oak blocking over the bridge seats preparatory to its being jacked down to its bearings. The oak blocking was required for the temporary support of the span at an elevation about 8 ft. 5¼ in. higher than its final position, this height being necessary to permit the skidway to pass over the parapet wall of the abutment. Before the aforementioned cast iron shoes and the skidway rails was placed a ⅞ in. steel plate, large enough to include both castings, with strips rivetted to its under side to form guides to engage the rails on the skidway.

When the scow was in position under the overhanging end of the main span, in front of the north abutment and transverse to the centre line of the bridge, two guide anchors were located on the opposite shore at an angle of 45 degrees. Holes were drilled in the rock and 3½ in. steel bars were grouted in a vertical position. To each of these anchors was secured a two-sheave steel block carrying four lines of ⅝ in. wire cable, forming the forward guy lines, which were wound up simultaneously on the drums of the hoisting engine, on the scow, as the span moved forward, steadying the floating end from any effect of wind or current.

The tackle used to haul the 415 ft. span into position consisted of two specially constructed steel pulley blocks, having fourteen sheaves each, through which was reaved a ⅝ in. diameter steel wire cable 1,000 ft. long, with a fall line leading back to the drum of a hoisting engine located on the land at the north end of the skidway. This engine was a 32 horse-power Beatty double-drum hoisting engine, with two cylinders, 8 in. x 12 in., boiler 41 in. diameter by 108 in. high, and capable of pulling 8,000 pounds on a single line.

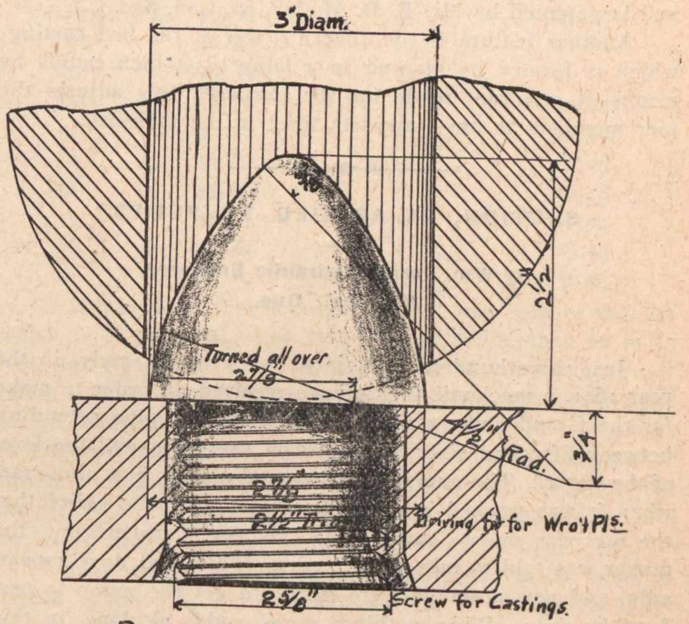
One of the large blocks was secured to the skidding-plate under the castings, and the other to the rear end of a string of bottom laterals belonging to a 250 ft. through span designed for the crossing of the Pickerel River, a short distance south of the French, consisting of two angles, 6 in. x 4 in. x ½ in. each, each used as pulling links. These were in turn secured by a pin to a box girder supported by struts in front of the north abutment. Each section of these laterals was about 30 ft. long, and when the two large blocks were brought together one or two sets of lateral links were removed and the blocks overhauled. When the last section was reached it was removed, and the forward block secured by the pin direct to the box girder.

When everything was in readiness, on the evening of October 27th, 1907, the scow was pumped out by means of the centrifugal pump, until the span was raised off the blocking. When this occurred it was found that there still remained a foot of water in the scow, showing that an ample margin of buoyancy had been allowed. At 8 a.m. on the 28th the engine was started, and with the assistance of a slight shove from two 40-ton hydraulic jacks, the large span started on its way, moving on the well-greased skidding rails at the rate of four to six feet per minute. Considerable time was lost owing to the inability of the small boiler of the hoisting engine to keep up a sufficient steam pressure, and also in the overhauling of the very heavy tackle.

The actual time occupied in moving the span was three hours, and in overhauling tackle, etc., four hours. The span was landed on its blocking at 4.05 p.m., without a hitch of any kind.

Trouble had been anticipated with settlement of the skidway on the new dump in view of the 640-ton concentrated moving load passing over it, but in no case was the settlement over six inches, and it was uniform at both sides, the greatest variation of the span from the level being about ⅝ of an inch in its width. So smoothly did the span move that it was possible to set it in its final location with the engine alone, without the assistance of jacks, and by means of the steering control afforded by the forward guy lines the span was within ¾ of an inch of its proper alignment when landed on the main pier on the south side of the river.

The lowering of the span to its final bearings on the bridge seats was accomplished by means of two specially constructed 500-ton hydraulic jacks. After the span was landed on the wooden blocking, the skidway castings and skidding plate were removed and cast steel cap plates were bolted to the under side of the floor beam, these plates being turned out to fit over a cast steel disc plate, 23 in. diameter by 3½ in. thick, placed on top of the plunger of each jack; between the bottom edges of these discs and the shoulders of the jack cylinders were placed a number of ¼-in. steel plate half-ring shims, as a safety precaution against accident should anything go wrong with the jacks; in which event the weight would be transferred to the massive jack cylinders.



DETAIL OF PINTLE

The jacks were each placed on blocking consisting of three super-imposed steel cylinders filled with concrete, over which were placed a number of cast iron cellular blocks, 2 ft. 10 in in diameter by 3½ in. thick. The ¼ in. shim plates were removed one at a time as the span was lowered, so that in no case was there left a space greater than ¼ in. between the under side of the disc and the jack shoulders. Before the last of these shims was removed the span was landed on the oak blocking, the jacks released and one or more sections of cast iron blocking removed, the jacks pumped up, shims replaced, and the operation repeated until all the cast iron blocking had been removed, when one of the concrete-filled cylinders was taken out, the casting and shims replaced, and so on until the span was landed on its permanent shoes. The oak blocking was also removed as the span was lowered, the top of it being kept high enough to free the jacks while shims were being adjusted.

When the span had been lowered about four feet at one end, the jacks were transferred to the other, and similar operations carried out there. That end, however, was lowered right down to the shoes before the jacks were returned to the end first lowered.

The bridge was designed by the Bridge Department of the Canadian Pacific Railway at Montreal. The substructure was built by the Toronto Construction Company, of Toronto, under supervision of Mr. F. S. Darling, Division Engineer of Construction, while the steel work was manufactured and erected by the Canadian Bridge Company, of Walkerville, Ont. Mr. A. L. Colby was manager of construction, and Mr. C. Prettie was general foreman in charge of the steel erection.

The writer believes that this is the longest and heaviest single track fixed span yet built and erected in Canada, or ever erected by the end-launching method.

The roller end of this bridge has a feature of special interest in the design of the bearings. This bearing is especially interesting, because it ensures movement of the rollers, which cannot get out from between the upper and lower plates, nor can they get out of square with the span. This, as you can see, is accomplished by means of four pintles or dowels, which are turned to a cycloid curve, and fit into holes drilled through the rollers, thus keeping all the moving parts in correct relation to one another.

Another interesting feature is the dust-guard, placed around these rollers, which consists of a frame of channels (planed to a trifle less in height than the diameter of the six-inch rollers), which have vertically slotted holes in them to take the trunnions at the ends of the rollers; the effect of this is that this frame bears hard upon the lower plates and hard against the ends of the rollers, making a practically dust-proof box, which, however, can readily be taken apart for inspection at any time. This bearing was designed and is patented by Mr. P. B. Motley, M. Can. Soc. C.E.

Another feature is the spherical top of the bed casting, which is formed by planing in a lathe to 36-inch radius by means of quadrant made for the purpose; this adjusts the pier members to any imperfect level in the masonry.

SUCTION, AS APPLIED TO PUMPS.*

By Wm. Perry, Hydraulic Engineer, Montreal, Que.

Just three hundred and sixty years ago, namely, in the year 1641, a mechanic in Florence received an order to make for the Grand Duke a pump, with a suction pipe extending between fifty and sixty feet between the valve and the level of the water. The pump was made and placed, but, of course, when it was worked it raised no water. In the belief that the fact was due to some defect in the construction, the maker was told to take it to pieces. This was done repeatedly, and new attempts were made to get the pump to perform its duty. When nothing more could be done in this way, the superintendent of the Grand Duke's waterworks consulted Galileo, then eighty years old, blind and within a few weeks of death. The philosopher had never seen reason to doubt the truth of the opinion universally prevalent at the time, that nature "abhors a vacuum;" it was universally thought that the power which raises water in pumps in some occult force, which, resisting all attempts to form a void, instantly presses water up the pipes when the air previously in them has been exhausted by the piston. When the whole circumstances of the difficulty at Florence were placed before Galileo, he could only reply that nature's abhorrence to a vacuum is limited, and ceases to operate above the height of thirty-three feet. This opinion, given without opportunity for due examination, was probably not quite satisfactory to Galileo at the time. Within two years Torricelli, who lived with his family, and assisted Galileo during the last three months of his life, was able to announce that this "occult force" was the pressure caused by the weight of the atmosphere.

This important fact he first established by an experiment as simple as it was ingenious and conclusive. He had made a model of the Grand Duke's pump, which had a suction tube sixty feet long placed perpendicularly, with its lower end in water; when the air at the top was exhausted, Torticelli found medium employed was quicksilver, which is about fourteen or 33 feet. The length of the pipe was next reduced to forty feet, but without better success. It then occurred to the experimenter that if it were indeed the weight of the atmosphere which sustained the water in the pipe, a substance other than water would rise to a height in the tube exactly in proportion to the relative specific gravity of water and of the other substance employed. But a short time elapsed before this thought was submitted to the test of an experiment. The medium employed was quick-silver, which is about fourteen times heavier than water; and when a vacuum was produced in the top of a tube, the lower part of which was filled with quicksilver open to the pressure of the atmosphere, it was at once seen that the column was supported at a height of only one-fourteenth that of the column of water.

The new doctrine put forward by Torricelli was attacked with a virulence almost equal to that which a few years before, had been shown on the announcement of his master's discovery that the earth revolved round the sun. It is difficult enough now to see who or what was injured by Torricelli's discovery, but the Jesuits opposed it furiously, and perhaps, had a less liberal-minded Prince than Pope Innocent X. been on the throne of the Papal States, the young philospher might have been seriously impeded in his work, if not subjected to personal inconvenience. In the midst of the discussion to which his pronouncement gave rise, Torricelli died at the age of 39; this event took place in the year 1647.

The question was then taken up by Pascal, a French mathematician and divine. He verified the experiments which had been previously made, and varied them, using wine and other liquids, always arriving at the same result. Pascal also was the target for much sarcasm and small wit, and encountered hostility in various ways, but he persevered, and at length hit upon an experiment which he at once saw, if successful, must be universally accepted as conclusive. This was to repeat the experiment of Torricelli several times on the same day with the same apparatus, but at different altitudes. If the mercury rose in the tube to a great height at the bottom of a hill than it did at the top, it must clearly be owing to the greater weight of the longer atmospheric column at the lower level. "It is absurd to suppose," says Pascal, "that nature abhors a vacuum less at the summit of a mountain than it does at its base." On September 19th, 1648, at the time when English fanatics, who had intoxicated themselves with the blood of the Archbishop of Canterbury, were preparing to shed that of the King, M. Perrier, a brother-in-law of Pascal, ascended the Puy de Dome, near Clermont, the highest mountain in France, to ascertain by actual test whether the expected result followed or not. The mercury fell in his tube as M. Perrier ascended the mountain, and when he reached the top it stood three inches lower than it had done at the commencement of the upward journey. The experiment was repeated on different sides of the mountain and at different times, but always, of course, with a similar result. And thus it became satisfactorily established beyond question that the mysterious power which had for so long a time eluded the search of philosophers was merely the pressure due to the weight of the atmosphere.

Within a very few years from the date last named, some of the practical results of the discovery were already realized. In 1654 the air-pump was publicly exhibited before the Emperor of Germany. Perrier himself, after a little observation, saw how Torricelli's tube could be applied to the measurement of the varying pressures of the atmosphere, and the partial prognostication of the weather which is rendered possible; though if he could have seen the clock-faced instruments which now hang in her halls, stupidly marked "Change," "Rain," "Set Fair," etc., as if every different height of the barometer corresponded to its own unvarying weather, he would, perhaps, have paused before putting into the hands of foolish humanity his air measuring machine in the capacity of a weather glass. He also applied it to measuring the altitude of mountains, for which purpose its suitableness was at once apparent.

The establishment of the truth of Torricelli's supposition enabled mechanics, for the first time, to understand the cause of the action of a pump. They must, for centuries have observed this action, and have noticed its powerlessness at a greater depth than thirty-three feet, and every pumpmaker must in time, as a part of his mechanical training, have be-

*Paper read before the American Waterworks Association, Washington.

come acquainted with the fact. Why, then, did the Florence engineers try to satisfy the requirements of the Grand Duke when they must have known their endeavors would be fruitless? Probably just because they received the order to do so; the risk was not theirs, and perhaps they did not dare to disobey. The cause as well as the fact itself was now understood; it explained also the different results obtained from the same machine at different places. A pumping engine which would raise water thirty-three feet in a city of the plains would be quite ineffective for a similar depth in a mountain town. The fire engine, which does as much in London, can only "draw" from a depth of twenty-two feet in the City of Mexico, and on some parts of the Himalayas, should it be required in that region of eternal snow, not more than eight or ten feet.

Suction Hose or Pipes.

Are made of iron pipe, or wire covered with rubber all depending on the various conditions for which it is to be used.

Water is propelled through the suction pipe of a pump by the act of removing or lessening the pressure of the atmosphere on the surface of the water in the suction pipe. Properly speaking, there is nothing in the operation resembling that of suction. One end of the pipe being placed in the water, and the other end connected with the pump inlet which is closed by a valve, the stroke of the pump plunger has the effect of partially removing the air in the pipe. The surface of the water being then relieved of a portion of the atmospheric pressure, there is less resistance offered to the water rising in the pipe. The water outside the pipe, having still the pressure of the atmosphere upon its surface, is forced through the suction to supply the place of the excluded air. The water inside the suction rises above the level of that outside in proportion to the extent to which the pressure of air is removed. If, for instance, the pressure of air within the suction is reduced by the first stroke from 14½ pounds to 13½ pounds, the water will be forced up the pipe about 2¼ feet, because a column of water an inch square and 2¼ feet high is about equal to one pound in weight.

Upon the reduction of the pressure of the air contained in the suction from 14½ pounds to 13½ pounds per square inch, it is evident that unless the water ascended the pipe there would be an unequal pressure upon its surface inside and its surface outside the pipe. In consequence of the water rising 2¼ feet in the pipe the pressure upon the surface of the water, both inside and outside, is evenly balanced, as the pressure upon the water exposed to the full atmosphere is 14½ pounds upon each square inch of its surface, while that upon the same planes, but within the pipe, will sustain a column of water 2¼ feet high (weighing 1 pound) and 13½ pounds pressure of air, making a total of 14½ pounds. If, in consequence of a second stroke of the pump, the air pressure in the pipe is reduced to 12½ pounds per inch, the water will rise another 2¼ feet.

This rule is uniform, and shows that the rise of a column of water within the pipe is equal in weight to the pressure of the air upon the surface of the water without.

The distance water can be lifted through a suction pipe varies with the height above sea level and also with the pressure of the atmosphere, which is constantly varying, the usual range of the barometer at sea-level, being 28½ in. to 30½ in. At this level the column of water which the atmosphere will support is about 33 feet in height and a pump will "draw water," as it is called, this distance, but the force which sends the water into the pump at this height is so diminished as to be almost balanced by its own weight. For, although the atmosphere will support a column of water about 33 feet in height, it will only do so as long as the water in the pipe is stationary. If it is desired to keep the stream running, as in fire engine or pump practice, the atmosphere has to perform two duties, one of them being to sustain the weight of the water, and the other to keep it moving.

Thus taking the barometer at 28.5 in. about the minimum ever reached in the ordinary way at sea level in this country, if the lift is only one foot, not more than 0.43 pounds are required to counter-balance the weight of the water, and 13.57 pounds, are available to cause velocity. With a ten-foot lift 4.34 pounds are necessary to sustain the column of water leaving 9.66 pounds for velocity. With a 20-foot lift 8.67 pounds are required to sustain the weight of water and only 5.33 pounds are left for velocity. At a little over 32 feet the atmosphere can only sustain the water stationary in the pipe, all its own weight being necessary to counter-balance that of the water.

The following table gives the velocity of flow through a suction pipe in feet per second with various heights. Barometer 30, Thermometer 60 deg. Fahr.

Height of pump in feet.	Velocity of flow into pump chamber.	Height of pump in feet.	Velocity of flow into pump chamber.
1	46.16	18	32.21
2	45.45	19	31.19
3	44.75	20	30.14
4	44.01	21	29.06
5	43.28	22	27.93
6	42.33	23	26.75
7	41.77	24	25.52
8	40.90	25	24.23
9	40.20	26	22.80
10	39.39	27	21.41
11	38.57	28	19.85
12	37.72	29	18.16
13	36.86	30	16.29
14	35.98	31	14.18
15	35.07	32	11.70
16	34.14	33	8.52
17	33.19	34	2.89

It will be seen that a pump will not rise with a velocity which is of practical value at a greater depth than 24 to 25 feet, and this is about the extreme limit of a fire engine's or pump's efficiency. Such heavy duty as this cannot be done except under the most favorable conditions. There is, however, hardly any limit to the length of horizontal suction pipe through which a pump will draw, provided both the pump and the joints in the pipe are air-tight and the sizes are so proportioned as not to cause undue friction.

I have pumps in use with suction pipes half a mile in length 19-foot lift, 750 feet long, 20-foot lift, 3,000 feet long, 15-foot lift; all pipe in the lengths mentioned are cast iron and lead joints and have had no difficulty in any form. Care was taken to avoid all air pockets. When putting in the suction pipes, I would call attention to the use of a vacuum chamber on suction pipes and showing the importance of properly locating a suction air chamber on a pump and wish to remark how few appreciate that it is as important to provide an air chamber on the suction side as it is on the discharge side of the pump to avoid the noise and water hammer. I can mention many cases where suction air chambers have been placed and are of little or no use. My experience in pump matter is simply this, that water passing under or across the opening of an air chamber on the suction line when speeded up is of no use.

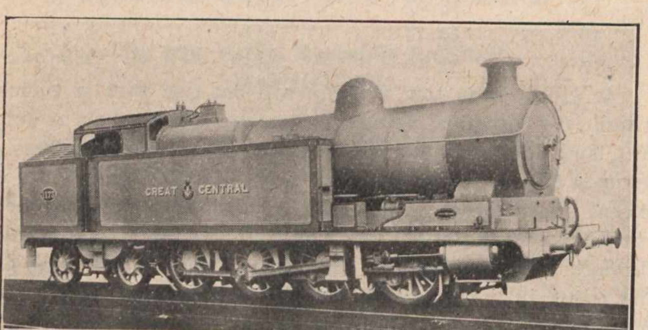
BRAZIL CEMENT TRADE.

Cement was imported at Santos to a value of $819,240 in 1905, as against $1,263,000 in 1904 and $1,594,700 (milreis) in 1906. A new company was registered in the beginning of 1907 under the name of the "Fabrica de Cimento Italo-Braziliera" with the object of manufacturing cement in the town of Rodovalho, in the interior of the State of Sao Paulo. The headquarters of the Company are to be in the city of Sao Paulo, with a capital of $800,000. The import trade in cement is now almost solely a German one, and the amount used is likely greatly to increase.

A man will die for want of air in five minutes; for want of sleep, in ten days; for want of water, in a week; for want of food, at varying intervals, dependent on various circumstances.

A POWERFUL TYPE OF "HUMP" ENGINE FOR THE GREAT CENTRAL RAILWAY, ENGLAND.

At Wath, located in the midst of the South Yorkshire coal field, the Great Central Railway Company of England has lately established a large concentration yard. The sidings cover an area of about 80 acres with a total length of permanent way of about 36 miles, and they are grouped in four sets, two of which are used for the reception of cars and two for sorting cars and marshalling trains eastward and westward bound respectively. The two groups of sorting sidings are arranged with a falling gradient, so that cars are pushed up to the "humps" between the reception and sorting sidings, and there detached and run by gravity into their respective roads. Leading from the junction with the main goods line to the "hump" for a distance of 2,870 ft. the lines have a rising gradient of 1 in 2,108, whilst for the distance of 3,937 ft. leading from the "hump" to the other junction with the main goods line the lines fall 1 in 40 for 250 ft., 1 in 60 for 300 ft., 1 in 100 for 300 ft., 1 in 200 for 400 ft., 1 in 300 for 300 ft., and are then on the level for 1,567 ft., subsequently falling 1 in 200 for the remaining distance of 820 ft. For use on these "humps" four special three-cylinder 0-8-4 tank engines—the first of this type and the largest and heaviest ever introduced on any railway in Britain—have been put to work, and the design of these is illustrated in the accompanying drawing and photograph. As the maximum



Three-Cylinder 0-8-4 "Hump" Engine for the G.C.R. Yards at Wath.

tractive effort is called for to enable these engines to readily handle and quickly accelerate trains up to a maximum of 70 loaded cars, or a deadweight of about 1,100 tons, the three-cylinder arrangement was utilized so as to secure the maximum advantage from the available adhesion weight. There are three cylinders placed in line below the smoke box, all using boiler steam, and of these the inside cylinder drives the crank axle of the second pair of coupled wheels, whilst the two outside ones directly operate the third pair. A separate "Stephenson" valve gear is provided for each cylinder, the slide valves of the outside cylinders working at the sides of the ports, and the inside valve works on the top of its cylinder. All three cylinders are carried in a slightly inclined position. The firebox is of the Belpaire type and there are four safety valves of the Ramsbottom type arranged for a working pressure of 200 pounds per square inch. The boiler is of the same type and has the same dimensions as those fitted in the Great Central Railway Company's standard Atlantic-type express passenger locomotives, and the wheels, axles, axleboxes, coupling, and outside connecting rods, motion, etc., are interchangeable with those of the standard eight-wheeled coupled mineral engines, whilst the inside motion corresponds exactly with that in the same company's latest design of six-wheeled coupled goods engines. These banking locomotives exert a drawbar pull of about 13 tons and maintain this up to nearly ten miles an hour. Reversing is effected by a steam and cataract gear, and brake blocks are applied to all wheels, including those on the bogie, the pressure being operated by steam controlled by a valve worked either by hand, or in connection with the vacuum brake. The following are the leading dimensions:

Gauge of rails	4 ft. 8½ in.
Cylinders, inside or outside	3, 1 inside & 2 outs.
" diameter and stroke	18 in. x 26 in.
" centre to centre	(outs.cy'ls)6 ft.8 in.
Wheels, diameter of front	4 ft. 8 in.
" " inside driving	4 ft. 8 in. } Coupled.
" " outside driving	4 ft. 8 in. } Coupled.
" " hind	4 ft. 8 in. } Coupled.
" " bogie	3 ft. 7 in. (4)
Boiler, length	15 ft.
" diameter outside at front	4 ft. 9½ in.
" height from rail	8 ft. 6½ in.
Tubes, number and diameter	221, 2 in.
" length between tubeplates	15 ft. 4⅜ in.
Copper box, length inside	7 ft. 9 11/32 in.
" width inside	3 ft. 4 in.
" height at front inside	6 ft. 7⅞ in.
" " back inside	5 ft. 5⅜ in.
Copper centre of boiler to roof, inside	10⅞ in.
Outer shell, length outside	8 ft. 6 in.
" width outside	4 ft. 0½ in.
" centre of boiler to top of shell	2 ft. 7⅜ in.
" shape of top and how stayed	Belpaire
Heating surface, tubes	1777.9 sq. ft.
" " firebox	153.1 sq. ft.
" " total	1931.0 sq. ft.
Area of fire-grate	26 sq. ft.
Boiler pressure	200 lbs. per sq. in.
Tractive power per lb. of mean effective pressure in cylinder	225.6
Wheelbase, front to inside dog	5 ft. 8½ in.
" inside dog to outside dog	5 ft. 5½ in.
" outside dog to hind	5 ft. 11 in.
" hind to centre of bogie	9 ft. 10 in.
" bogie wheelbase	7 ft. 6 in.
" extreme wheelbase	30 ft. 8 in.
Weight on rails, bogie	22 tons 19 cwts.
" each coupled axle	18 tons 8 cwts.
" total	96 tons 11 cwts.
Quantity of water	3,000 gallons
" fuel	4 tons of coal

The locomotives have been built by Messrs. Beyer, Peacock & Company, Limited, of Gorton Foundry, Manchester, to the designs of Mr. J. G. Robinson, the chief mechanical engineer of the Great Central Railway Company, England.

THE RENTAL VALUE OF A POWER PLANT.

"The rental value of a power plant depends upon its character and efficiency to produce power cheaply.

"The cost of producing power in small amounts is very much greater than in large amounts, and the amount which the lessee should pay may be obtained in comparison with the cost of producing the amount of power required with a reasonably efficient plant with steam power or by some other means. Thus, supposing the power to be rented is water power and plant, its value can be determined by estimating the cost of producing a uniform power by water power, supplemented by steam power if necessary, and comparing the cost of producing the same amount of power by steam power alone, in each case adding such charges as the lessee is to assume. The difference, if in favor of the water power, will represent the value of the power for the length of time the estimated cost covered.

"If the power plant be a steam plant, it is possible that it has no rental value; that is, it may be so wasteful that it would pay to replace or change parts of it to bring it into an economical state. If it is an economical plant, and is to be run by the lessee, he should pay such rent as will cover depreciation and a fair rate of interest, and assume repairs, insurance, and taxes, or pay enough rent to cover them.

CITY OF WINNIPEG, HIGH PRESSURE FIRE SERVICE.

Some three years ago the city of Winnipeg decided to install a high-pressure system for fire protection. At first it was feared the city at large would not vote funds for such a system which extended to only certain sections of the city, the parties most interested, those paying the heavy special conflagration insurance rate of 1 per cent. in the central congested district, were very eager to get a high-pressure plant which would relieve them of this heavy tax. After considerable negotiation by the city council it was agreed by the principal property owners that they would assume the cost of putting down the plant upon the same basis as they pay for their local improvements. It was arranged, therefore, to get the city charter changed, so that the new high-pressure system could be put down on that basis. The law was changed and the city advertised its intention to proceed with the improvement. No contrary petition was presented to the council. The first advertisement stated that the system would cost $380,000. Plans, however, were changed, and they were made to take in a larger area. The amended improvement was estimated to cost $560,000, and to this there has been added one or two extensions which in the aggregate would not exceed $50,000.

This fire service equipment now being installed in Winnipeg consists of a central pumping station on the banks of the Red River, from which water is forced through special mains laid throughout the business portion of the city. Hydrants are fixed at convenient distances, so that a number of streams can be concentrated on any one point.

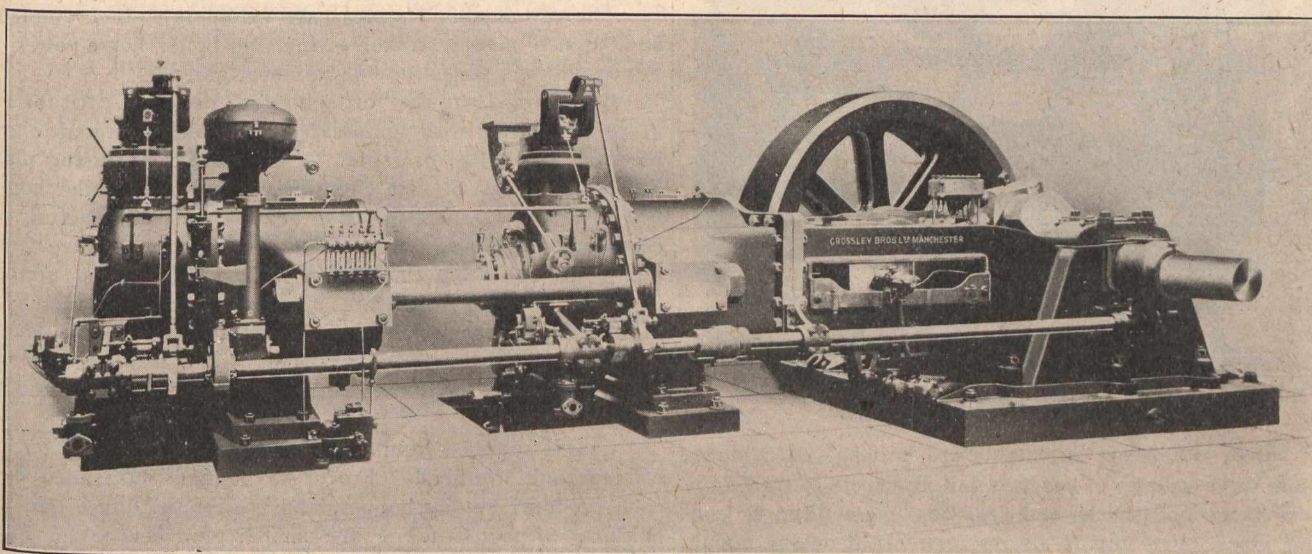
The water pressure is 300 lbs. per square inch, and the maximum capacity of the plant is 9,000 imperial gallons per minute.

The power-house is a magnificent station, finished in the best style. The building is 158 ft. long by 92 ft. broad. It is divided into two main bays. Supporting columns are fixed in the centre of the building designed to carry the roof and the two 20-tons overhead travelling cranes. These cranes, one in each bay, travel the full length of the building. They are operated by hand from the engine-house floor. The pumping units are six in number, and are situated 3 in each bay. They are divided up into 4 large units of 1,800 gallons per minute, and two small of 900 gallons per minute.

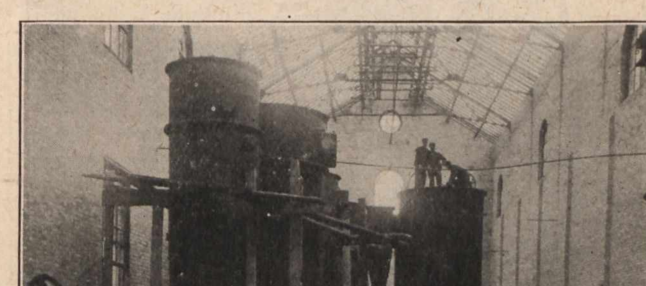
The pumps are driven by gas engines. The engines are located on the main floor, which is about 180 feet below the street level. The pumps are located in pockets 12 feet below the main floor. Each set stands complete by itself. The drive from the engine is through a Hele-Shaw Friction Clutch, to an extension shaft. On the later is keyed a mild steel pinion which gears with a cast steel spur wheel keyed to the pump crankshaft. The ratio of gear is about 3½ to 1. The pumps are of the three-throw vertical double acting piston type. The barrels are 13⅞ diameter by 18-inch stroke, and the speed is 35 revolutions per minute. The crank shaft is one mild steel forging, machined all over. The throws are slotted out of the solid.

Connecting rods are of mild steel. All bearings are of gunmetal. The high-speed bearings are of the ring lubrication type. The main bearings are fed by drop-feed lubricators.

The cross-heads are of cast-steel. Crosshead guides are of cast-iron and are of the circular type. They are bolted to the main standards, and serve to bind these together. The pump barrels are lined with gunmetal, and the piston rods are of phosphor bronze. Pistons are of gunmetal, and in three pieces having double L leathers. Each pump-barrel has two valve chambers. The chambers are fitted with deck plates which carry the valves. The latter are about 4-inch diameter, and there are about 13 in each deck plate. They are designed to give ample area through the grids. The valve proper is of vulcanite. The disc is kept on its seat by a phosphor bronze spring. The connecting ports between the valve chambers are very large. Handholes are placed in suitable places so that the small valves can be replaced without removing the covers. The whole of the pump is carried on one soleplate which is bolted to the concrete by 12 heavy binding bolts. Cast-iron washers are built in the concrete, and the bolts can be lifted out and in as required.



Crossley Gas Engine.



View of Producers.

There are two main suction pipes, 24-inch diameters at the larger end. They are carried by steel H beams grouted in the concrete. The pipe trench which is in the centre of the buildings is 18 feet below the main floor. Each pump is connected by branch pipes to the suction mains, and valves are provided so that any pump can draw water out of either main. Each pump has an air vessel on both suction and delivery branch pipes. The suction mains are run from end to end of engine house, and at the east end cross over and run into the wells. There are two suction wells about 9 feet square, divided by a concrete wall. They are about 40 feet deep from the street-level.

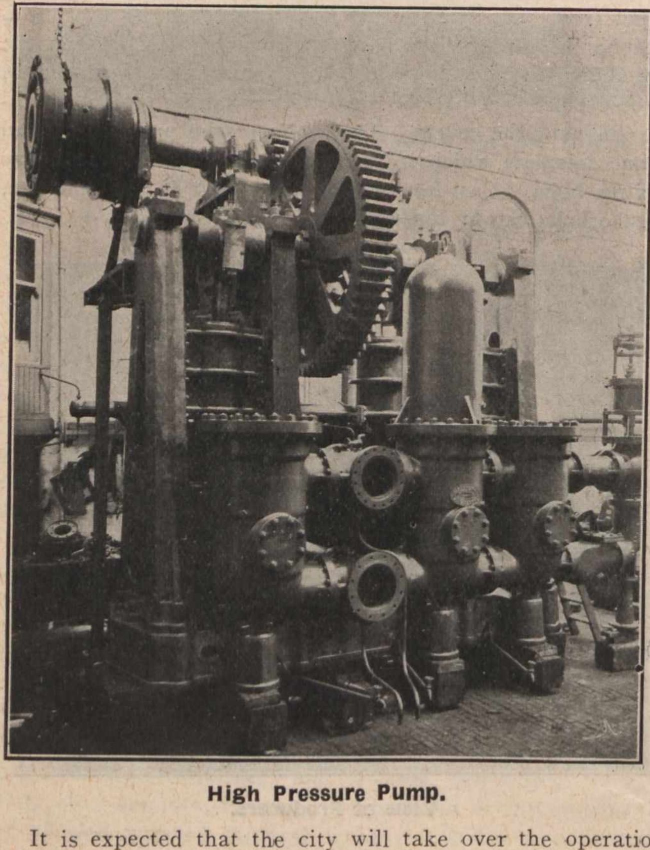
A culvert 36 inches in diameter runs from the wells into the river. The intake is carefully protected from mud.

There are two 20-inch delivery mains in engine-house. All pumps are connected to these. Either can be isolated in case of a burst, and water pumped into the other. Each main has a mild steel air vessel, 30-inch diameter by 18 feet high.

Shop Showing Traveller's Crane.

Relief valves which are adjustable are fitted to each pump. They are large enough to pass the full discharge of the pump. The discharge goes back to the suction main through connecting pipes. Pressure is always maintained on the mains. The city supply the C.P.R. with water at 120 lbs. pressure, and this keeps one unit running night and day.

The pumps with all connections were built by Glenfield & Kennedy, Limited, Kilmarnock, Scotland.



High Pressure Pump.

It is expected that the city will take over the operation in about 2 months' time. The whole has been carried out under the supervision of H. N. Ruttan, City Engineer.

Th representatives in charge are W. E. Phelbrow, for Crossley Bros., and A. E. Myles, for Glenfield & Kennedy, Limited.

The gas engines are manufactured by Messrs. Crossley Bros., Manchester, England, and are all constructed with two single acting tandem cylinders; water-cooled pistons and rod; balanced, water-cooled exhaust valves; and duplicate low-tension magnet ignition.

The four large engines have cylinders 32-inch diameter and 36-inch piston stroke, and 520 boiler horse-power when running at 125 revolutions per minute on producer gas, and were tested at Messrs Crossley's works by Dr. Nicholson, D.Sc., giving over 32 per cent. efficiency.

A very simple governor gear is fitted which varies the quality of the mixture without reducing the quantity, the compression remaining the same at all loads. The gas valve is of the piston type concentric, with the main inlet valve, and operates in a vacuum cylinder, the degree of vacuum being controlled by a small pilot valve operated by the governor, and opens the gas valve earlier or later in the suction stroke, as the load on the engine may require.

The two smaller engines have cylinders 22-inch diameter and 30-inch piston stroke, giving 270 boiler horse-power at 150 revolutions per minute on producer gas.

Governing is on the "hit-and-miss" principle. All the engines are started with compressed air, which is stored in two receivers at 200 lbs. pressure. A duplicate compressing plant consisting of two S. type Crossley engines of 20 boiler horse-power capacity, operating two belt-driven, single-acting air compressors. These engines also operate a small three-throw pump, used to drain the central main pit. Gas is supplied from a "Crossley" pressure plant which is constructed to produce gas from anthracite, bituminous, or lignite slack, and consists of two 600 horse-power and two 1,000 horse-power producers, each fitted with separate superheaters and regenerators.

Coal is supplied from a large storage hopper, by a bucket elevator and overhead conveyor to bunkers suspended over each producer supply hopper, and is dropped direct into the producer without handling, the smaller producers taking four-hundred weight, and the larger, ten-hundred weight at each charge. Ashes are removed through water-luted pits at the bottom of each producer, and poking is carried out from the top platform, in accordance with the latest practice. The hot gas from each producer passes through the superheater and regenerator tubes to one hydraulic main and thence to four vertical coolers or coke scrubbers. These shells are 30 feet high and 5 feet diameter, and a constant stream of water is passed through, cooling the gas and removing the heavy tar, the hot water then flows along a large cooling sump, the tar skimmed off, and again passed through the coolers by a small centrifugal pump.

The cooled gas is next passed through Crossley's Patent Rotary Extractors, which finally removes all the fine tar and reduces the temperature to that of the surrounding atmosphere. Finally, the gas is passed through sawdust scrubbers to remove all moisture and then through suitable valves to a storage gasholder of 250,000 cubic feet capacity.

Air is supplied under pressure to the producers by three steam-driven "Roots" blowers, the exhaust steam passing in with the air to the producers, and the boilers are fired direct with the gas, saving a large amount of labour.

The centrifugal pumps and rotary tar extractors are operated by two Crossley's R. type gas engines of 18 boiler horse-power, through overhead shafting.

The engines, pumps, and shafting are in duplicate, and fitted with duplicate pullies, and a spare blower and extractor is supplied, to prevent any possibility of a stoppage.

This plant has now been in operation, night and day, for nearly three months, satisfactorily.

PEAT FERTILIZER.

A dry peat collector, built by Sheldon's Limited, of Galt, Ont., under contract of W. A. Milne & Sons, Hamilton, will be sent at an early date to Pennsylvania for the Columbia Dryer Company, who furnish peat for "Fertilizer Filler," and who will use this machine in supplying the demand. The machine is the invention of Milne & Sons, who hold the patents for it. The Columbia Dryer Company will give the machine a thorough test and should it prove satisfactory the inventors will no doubt have orders for more.

ELIMINATION OF FIRE RISK.

It is now universally recognized that no material is so thoroughly fireproof as reinforced concrete. Steel construction, although not itself inflammable, is of all materials most disastrously affected by heat. In fact, the supporting members of such a building, with their thin webs and flanges, could hardly be designed to be more readily susceptible to the effect of heat, whereby their strength is suddenly and greatly decreased.

Even steel protected with wood is better than the naked steel, but reinforced concrete with all steel enclosed is resistant to any fire if the protection be of sufficient thickness.

In a recent discussion, Mr Leonard C. Wason, president of the Aberthaw Construction Co., Boston, Mass., pointed to the fact that, even though the building itself may be absolutely fireproof, and hence that sprinklers may appear unnecessary, its contents may be so much more valuable as to make it poor business policy to omit them. The total cost of initial installation of a complete sprinkler service is, roughly, four cents per square foot of floor. Mr. Wason referred to the recent Deering-Cousens fire in Portland, Maine, where the contents were worth fully ten times the cost of the building, and showed that to use sprinklers and extinguish the fire before the contents were entirely consumed would under such circumstances show a vastly greater saving than to omit them and lose the contents of even a single room in a building so fire-resisting as to prevent its spread. Of course, in mill construction such relations between cost of building and contents seldom exist except possibly in storehouses. Hence, the more general use of the unsprinkled reinforced concrete building. But, as Mr. Wason further showed, the merit of reinforced concrete is not alone in its fireproof qualities. It has in addition a degree of permanence possessed by no other type of construction which warrants its general use.

TABLE MANILA ROPE.

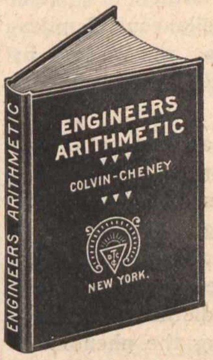
SIZE. Cir.	Dia.	Weight Per Coil (1,200 feet).	Feet Per Pound.	Safe Working Load.
½ in.	3-16 in.	35 lbs.	50 ft.	183 lbs.
¾ "	¼ "	45 "	40 "	207 "
1 "	5-16 "	50 "	30 "	333 "
1⅛ "	⅜ "	55 "	24 "	425 "
1¼ "	7-16 "	65 "	20 "	625 "
1½ "	½ "	85 "	14 "	800 "
1¾ "	9-16 "	120 "	10 "	1,100 "
2 "	⅝ "	160 "	7½ "	1,333 "
2¼ "	¾ "	200 "	6 "	1,567 "
2¾ "	⅞ "	300 "	4 "	2,167 "
3 "	1 "	350 "	3½ "	2,500 "
3¼ "	1 1-16 "	420 "	2⅞ "	2,967 "
3½ "	1⅛ "	480 "	2½ "	3,500 "
3¾ "	1¼ "	560 "	2⅙ "	4,167 "
4 "	1 5-16 "	640 "	1 9-10 "	4,667 "
4¼ "	1⅜ "	720 "	1⅔ "	5,133 "
4½ "	1 7-16 "	800 "	1½ "	5,400 "
4¾ "	1½ "	900 "	1⅓ "	5,667 "
5 "	1⅝ "	1,000 "	1 1-5 "	6,667 "
5½ "	1¾ "	1,200 "	1 "	8,333 "
6 "	1⅞ "	1,440 "	10 in.	9,167 "
6¼ "	2 "	1,550 "	9 3-10 "	10,000 "
6½ "	2⅛ "	1,675 "	8 3-5 "	11,000 "
7 "	2¼ "	1,950 "	7 2-5 "	12,333 "
7½ "	2⅜ "	2,240 "	6½ "	14,333 "
8 "	2 9-16 "	2,540 "	5⅔ "	16,667 "
8½ "	2¾ "	2,880 "	5 "	18,667 "
9 "	2⅞ "	3,200 "	4½ "	20,667 "
9½ "	3 "	3,600 "	4 "	22,667 "
10 "	3 3-16 "	4,000 "	3 3-5 "	25,000 "

Taylor Eng. Co., New York.

ENGINEER'S LIBRARY

BOOK REVIEWS.

Books reviewed in these columns may be secured from Vannevar & Co., 438 Yonge Street, Toronto, Ont.



Engineers' Arithmetic.—By Fred. H. Colvin. Publishers, the Norman W. Henley Publishing Co., 132 Nassau Street, New York. Pages, 122. Price, 50 cents.

A pocket book, containing the principles involved in making such calculations as come into the practical work of the stationary engineer. This is the second edition of this concise and useful publication, which is a companion to Machine Shop Arithmetic by the same author. Besides many formulæ and explanations there are several convenient tables, such as properties of metals, circumferences and areas of circles and properties of saturated steam. The glossary of terms used in steam engineering, though brief, is as complete as a pocket edition can be.

Electrical Energy.—By Ernst J. Berg. Published by the McGraw Publishing Co., New York. Pages, 184; 129 illustrations. Price, $2.50 net.

The book is compiled from a series of lectures delivered to the engineering students at Union University for the purpose of bridging the theoretical instruction given in the university and the practical problems of commercial engineering. The book consists of two sections. The first forms an accurate and convenient solution of transmission line problems, discussing the choice of frequency, arrangement of circuits, most economical voltage, line constants, transformer connections, and treating fully the effects of short circuits, open circuits, and accidental grounds on the line. It also deals with the inductance and capacity of cables, with the effects of sheathing on the same, inductance and static effects of telephone lines under various practical arrangements. The section is treated mathematically, but the systematic substitution of actual constants in equations allows the physical relations involved to be readily followed. Live phenomena are graphically illustrated. The second section deals with the power station. Generators are discussed. giving their characteristics, and describing several types. Transformers. connections, losses, and regulation and efficiency are treated of, with solution of problems. As in the former section, practical examples have been used freely for illustrating the theoretical deductions. The book will be found useful to the instructor and student as well as to the electrical transmission engineer.

F. A. G.

The Standard Handbook for Electrical Engineers.—Written by a staff of specialists. Pages, xx.+1283; 1,271 illustrations; flexible leather binding, 4 x 7 inches. Published by McGraw Publishing Co., 239 West 39th Street, New York. Price. $4.

A great deal of credit is due for the painstaking way in which the immense amount of data and figures has been collected and its presentation in a rational and consecutive order. The entire field of electrical engineering has been covered, and the subject matter divided off into twenty sections, each section being complete in itself, forming a condensed treatise of the subjects covered by its title. The use of heavy type for drawing attention to the subject matter of each paragraph is excellent, and is carried out consistently. The list of sections and authors is as follows:

1. Units, by Otis Allen Kenyon. 2. Electric and Magnetic Circuits, by Otis Allen Kenyon. 3. Measurements and Measuring Apparatus, by Otis Allen Kenyon. 4. Properties of Materials, and (5) Magnets by Otis Allen Kenyon. 6. Transformers, by A. S. McAllister, Ph.D. 7. Electric Generators, by H. M. Hobart and Otis Allen Kenyon. 8. Electric Motors, by A. S. McAllister, Ph.D. 9. Batteries, by Edward Lyndon. 10. Central Stations, by R. C. Beardsley and George Shaad. 11. Transmission and Distribution, by Arthur Vaughan Abbott and Otis Allen Kenyon. 12. Illumination, by Louis Bell, Ph.D. 13. Electric Traction, by A. H. Armstrong. 14. Electro-Chemistry, by E. F. Roeber, Ph.D. 15. Telephony, by Kempster B. Miller. 16. Telegraphy, by Otis Allen Kenyon. 17. Miscellaneous Applications of Electricity, by Otis Allen Kenyon. 18. Wiring, by William H. Onken. 19. Standardization Rules. 20. Tables and Statistics.

The index covers 54 pages, and is a combination of topical and alphabetical indexing, and a notable feature is the method used, all references and cross indexing being made to section and paragraph, each paragraph being numbered. This facilitates the use of data and material. The use of curves for presenting data is to be commended, the graphical method in many cases having a distinct advantage over tables, inasmuch as the law governing the phenomena can be readily seen, and it gives data for any set of conditions without the necessity of interfolation. The section on Transmission and Distribution will be very acceptable to experts on this work for the useful tables and data it contains. The subject matter has been logically arranged, and the work is first-class, the illustrations numerous, and the uniform use of symbols throughout is commendable, although the book is not altogether free from errors, which could hardly be expected in the first edition of a book covering such a vast amount of data and material. A number are typographical, but a few have been carried through the tables, but these are readily found, and it suffices to say that every electrical engineer should find it of much value; it will also prove a mine of information to the students and a valuable handbook for the practical engineer.

F. A. G.

Profit-making in Shop and Factory Management.—By Charles U. Carpenter. Publishers, the Engineering Magazine, New York. Size, 6 x 9; pages, 146.

Profit-making is a fascinating subject in any sphere; in factory management it is not only fascinating, but necessary.

During 1907 Mr Charles U. Carpenter, president of the Herring-Hall-Marvin Safe Co., contributed to the Engineering Magazine a series of articles on Profit-making in Shop and Factory Management. These articles have been revised, enlarged and rearranged, and are now offered in book form. The suggestions are practical, concise, yet complete, and give evidence of being the ideas of an experienced manager or superintendent. The field covered is large, including Reorganization; the Committee System; Reports: Their Necessity; The Functions and Results to be obtained from the Various Departments; the Wage System; Stock and Cost; the Selling Department, and the Organization in the Executive Department.

PUBLICATIONS RECEIVED.

Falls of Niagara.—A report by Dr. J. W. W. Spencer, F.G.S., dealing with their evolution and varying relations to the Great Lakes; the characteristics of the power, and the effects of its diversion. Issued by the Department of Mines, Geological Survey Branch, Ottawa, Canada. Size 6 x 10, page 490, illustrated.

General Contracts for Structures of Reinforced Concrete With Brick or Timber is the title of Circular No. 16, issued by the Aberthaw Construction Company, of Boston, Mass. It describes various contracts executed by this company, including the Harvard Stadium, the standpipe at Attleboro', Mass., which is the largest yet built, various textile and paper mills, fireproof structures, dams, coal pockets, residences, etc.

Mining Operations in Quebec.—The report for the year 1907, of J. Obalski, Superintendent of Mines for Quebec. Besides a brief statement of mining operations for the year it also gives an account of explorations north of Pontiac and the survey of Lake Temiscamingue.

CATALOGUES AND CIRCULARS.

Steel Concrete Chimneys.—The Weber Steel Concrete Chimnew of Montreal, rooms 36-36a Guardian Building, tell in this booklet of the steel concrete chimney, as to design, construction, economy, life and stability. Size, 4 x 10.

Machine Tools.—Broom and Wade, High Wycombe, England, London office, 27 Clements Lane, are distributing descriptive catalogues of their high-speed oil engine, air compressors and machine tools.

Fan Motors.—The Canadian Westinghouse Company, Limited, Hamilton, Ont., are distributing a very pretty and complete catalogue of electric fan motors. Both direct and alternating current fan motors are listed. Pages 40, size, 6 x 9.

Electric Switches.—The Hill Electric Switch Company, 1560 St. Lawrence Boulevard, Montreal, have issued a bulletin, size 6 x 8, describing their type D switches.

Roller Bearing.—Hyatt Roller Bearing Company, Newark, N.J., in Bulletin No. 31 outline the benefits of roller bearings and give dimensions of over 300 sizes. The Hyatt bearing is applicable to hundreds of forms of machinery and will effect economies in friction loads. They have been adapted as a standard by many prominent manufacturers, who have been desirous of increasing the saleability and efficiency of their products.

Gaskets.—The Smooth-On Manufacturing Company, Jersey City, N.Y., will be pleased to send a sample Smooth-On Coated Corrugated Gasket free to any engineer sending his name and business address; also one of the circulars regarding this gasket.

Electric Supplies.—The Concordia Electric Wire Company, 64 Salisbury Road, London, Eng., have for distribution a series of catalogues describing their cable connections, adjustable armature coil winding and pipe bending machines.

Gas Engines.—The Bruce-Meriam-Abbott Company, Cleveland, Ohio, are distributing a catalogue describing their two and four cylinder type vertical gas engines.

Engine Specialties.—The Lunkenheimer Company, of Cincinnati, Ohio, have issue a 570 page illustrated catalogue and price list describing many specialties in brass and iron valves, whistles, gauges, injectors, lubricators. The catalogue also contains some 50 pages of tables. This very complete handbook will be furnished to engineers upon request.

TO DEVELOP JAP WATERPOWERS.

The development of the water power of Japan has been undertaken by a Japanese-English-American syndicate. At a meeting held recently $6,000,000 was pledged for this purpose, Japanese contributing half of the amount.

The city of Hamilton, Ont., with a population of 65,000 people, consumed for all purposes during 1907 134,130,191 imperial gallons of water. To pump this water required one million pounds of coal (slack, not mine run).

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.

RAILWAYS—STEAM AND ELECTRIC.

Cape Breton.

SYDNEY.—It has been said that negotiations are proceeding between the Cape Breton Electric Company and the Sydney and Glace Bay Railway Company, having as their object the acquisition by the former of the latter's lines, but the report is denied.

Ontario.

BROCKVILLE.—Mr. C. Beresford For of Sir Douglas & Co., London, Eng., has made a trip over the line of Ottawa and Brockville Electric Railway. Almost unlimited power may be secured along the route. At Hog's Back is a forty foot fall, at Manotick thirty feet, dams of six, eight, and twelve feet above Burritt's Rapids, to say nothing of the rapids at Merrickville. After returning to Ottawa Mr. For will report to English investors who may proceed with construction.

NORTH BAY.—The rails on the T. & N.O. Railway are now down to the Driftwood River, which is only thirty-five miles south of the surveyed route of the National Transcontinental and 217 miles north of North Bay. A bridge 490 feet long is being constructed over the Driftwood River, and will be completed about July 10.

PORT ARTHUR.—A freight dock to be used co-jointly by the G.T.P. and C.P.R. is likely to be built here within a year.

PORT HURON.—The third section of the Michigan Central Tunnel is now in place. The twin tube is 200 feet long, and the two that were sunk last year are of the same length, and the two that were sunk last year are of the same length. The work is thus 600 feet from the American shore. Work on the cofferdam and the placing of concrete around the tubes laid will begin at once. The foundation is constructed of concrete and the tubes are to be covered with the same material.

Manitoba.

ST. BONIFACE.—The St. Boniface Council desires to have the Winnipeg Street Railway Company establish a belt car line in that town.

WINNIPEG.—The heaviest steel which has yet been laid on the central division of the Canadian Pacific, will be laid next month on the Winnipeg Beach branch. This is 85-pound steel, the standard steel of the company being 80 pounds. Much of the steel that is at present on the Winnipeg Beach line is 56-pound.

Saskatchewan.

SASKATOON.—Everything in connection with the building of new railways in this district is being rushed, and it looks as if Saskatoon will have connection via both the Grand Trunk Pacific and the C.N.R. within a month. Work on the new Goose Lake branch of the C.N.R is progressing rapidly, and it is expected that steel laying will commence in the very near future.

WYNARD.—This town is the C.P.R divison point on the Winnipeg-Edmonton main line west of Sheho, and is a busy and hustling place. Contractor J. G. Hargrave's outfit, consisting of 76 teams, is busily engaged throwing up the last two miles of grade into Wynard, and as soon as this is completed, the steel will be laid from Leslie and a train service will be operated by July 1. Engineer J. A. MacKenzie has charge of the work for the company and is camped just west of the town.

British Columbia.

GRAND FORKS.—Fred. A. Sammons, an experienced timber man of this district, is reported to have been awarded a large contract for getting out piling for the Canadian Northern Railway. His first shipment of thirty-five cars of piling is already being taken out. It is also stated that the Canadian Northern Railway will award contracts in the immediate future for the cutting of two hundred thousand telegraph poles which will be cut on the north fork of Kettle River as well as the other districts surrounding Grand Forks.

HEDLEY.—New interest has been lent to the local railway situation by reports of operations by two parties of C.P.R. surveyors under Engineer Kerry. One party is said to be exploring from Aspen Grove in the direction of Trout Creek on Okanagan Lake, and the other is working down the Otter. The problem of getting across the ranges and down Trout Creek would seem to involve considerable of the toboggan slide style of railroad engineering which most railroads are trying to cut out nowadays.

PRINCETON.—The C.P.R. has started surveying up the Coldwater, which is part of its route via Tulameen to Princeton.

SEWERAGE AND WATERWORKS.

Quebec.

MONTREAL.—The difference between the City of Westmount and the Montreal Water and Power Co. in regard to the water supply bids fair to come to a speedy settlement. The council and the company have come to an agreement. The new proposition has still to meet the approval of the City Council, and will then be put before the ratepayers as a by-law. The company agrees within eighteen months to install a new intake 800 feet up stream and 1,900 feet from the present well. If the city demands a filtration plant, the company will supply it at an increased cost of 27½ per cent. High pressure in the upper levels is guaranteed. The city will get its water at 12 cents instead of 15 cents per thousand gallons. This will be presented to the council early in June.

Ontario.

GUELPH.—At a meeting of the Water Commissioners yesterday afternoon, the tenders were let for the new 3,000,000 gallon pump to be installed at the water pumping station. The contractors who put in the successful tender were Messrs. John Inglis Company, of Toronto. The price of the accepted was a few hundred dollars above $14,000. The new pump is to be installed by the 15th of August.

KENORA.—On and after June 1st the town will receive its water supply through the medium of an electric pump. Under the present regime of steam pumps upwards of two cords of wood are consumed daily at an approximate cost of two hundred dollars a month. After June 1st this item will be reduced by about $180, thus leaving a margin of about $20, which will be the actual monthly bill for the electric power and other running expenses of the new pump. The pump was manufactured by the Morris Machine Company, of Baldwinsville, N.Y., and has a capacity of one and a half million gallons per twenty-four hours, with a maximum pressure of 120 pounds. It is run by a Westinghouse 100 horse-power, 2,200 volts, 3-phase 60 cycle, induction motor.

NEW LISKEARD.—The action brought by Mr. J. H. Fitzpatrick against the town of New Liskeard, Ont., for $43,000 has been decided in favour of plaintiff, the amount awarded being $5,240 with costs. The plaintiff was the owner of a spring from which he contemplated supplying water to New Liskeard and Haileybury, after forming a company to provide the necessary capital. The Town Council of New Liskeard expropriated the property, and the arbitrators called in to assess the value awarded Mr. Fitzpatrick only $1,500.

ST. THOMAS.—A by-law will shortly be submitted to raise $31,000 to be expended on a septic tank, filter beds and the purchase of land required for same.

TORONTO.—The Provincial Board of Health at their last meeting reported on the following sewerage schemes: Guelph complained of the contamination of the River Speed by sewage, and an inspection was ordered. Amended plans for the sewerage system of Preston were approved. Liquifying tanks and secondary treatment were considered. Plans for the village of L'Original were submitted and consideration deferred. Midland plans were referred back for improvement. The district of Ottawa South plans draining 65 acres were also deferred for further information. Extension of Brantford waterworks system was referred to a special committee for report.

British Columbia.

NANAIMO.—The city of Nanaimo has been granted a record of three hundred inches at the South Fork of the Nanaimo River. They are now seeking a loan with which they purpose constructing a pipe line and other necessary works to provide water for a city of 100,000 inhabitants.

VERNON.—The plans of Messrs. Galt & Smith, consulting engineers, of Toronto, for a complete sewer system and sewage disposal works have been accepted by the Council of Vernon, B.C. The general system will consist of about five miles of pipe sewers, sizes 18 to 8 inches diameter, with all necessary appurtenances. The disposal works will be located about 1¼ miles from the town on the main creek. The first installation will consist of a septic tank, with a continuous filter, and provision will be made for future extensions. The estimated cost of the work is $57,500.

TENDERS.

Ontario.

COBOURG.—Tenders for Cobourg Harbour Breakwaters will be received at this office until 4.30 p.m. on Monday, June 29, 1908, for the construction of two breakwaters at Cobourg, Northumberland County, Ont. Fred. Gelinas, secretary, Department of Public Works.

GUELPH.—Tenders will be received until June 16th for teaming, excavation, laying and back filling for a 24-inch earthenware water conduit 20,000 feet in length, also for a cast ironpipe. Davis & Johnston, engineers; J. J. Hackney, manager, Guelph Waterworks. (Advertised in the Canadian Engineer.)

HANNON.—Tenders wiil be received up to June the 10th for digging holes and setting poles for the Boston and Binbrook Telephone Company. For particulars apply to the undersigned. T. E. Tidey, Hannon, Ont.

OTTAWA.—Tenders will be received at the Department of the Interior, Ottawa, up to noon of the 8th day of June, 1908, for the furnishing of forty-five thousand iron posts, small size, and thirteen hundred iron posts, large size, for use on the survey of Dominion lands, to be delivered in specified lots at Winnipeg, Man., Saskatoon, Sask., and Edmonton, Alta. P. G. Keyes, Secretary, Department of the Interior.

PORT ARTHUR.—Tenders will be received by the undersigned up to 12 o'clock noon of Monday, June 8th, 1908, for concrete sidewalks. J. McTeigue, clerk.

PORT ARTHUR.—Tender for work will be received up to Thursday, June 11th, 1908, for alterations to the gaols at Port Arthur, Kenora, and Sudbury. H. F. McNaughton, secretary, Public Works Department, Ottawa.

WINDSOR.—Tenders will be received by the undersigned up till noon on Tuesday, the 9th day of June, for ten pairs of rubber boots (hip length), ten rubber coats, nine aluminum helmets, and 500 feet of 2½-inch fire hose, all of above supplies to be delivered free on board cars at Windsor. Stephen Lusted, city clerk,

Manitoba.

WINNIPEG.—Sealed tenders will be received by the undersigned up to noon of Monday, June 8th, 1908, for the excavation of the proposed ditches and clearing of right-of-way in Drainage District No. 17, situated in Townships 36 and 37, Ranges 24 and 25 west, in the Municipality of Minitonas. R. Rogers, Minister of Public Works.

WINNIPEG.—Tender for St. Andrew's Rapids Works will be received until Wednesday, July 8, 1908, for the construction of movable dam, steel service and highway bridge, repair shop, etc., at St. Andrew's Rapids, Red River, Province of Manitoba. Fred. Gelinas, Secretary Department of Public Works, Ottawa.

Saskatchewan.

MOOSE JAW.—Tenders will be received up to Monday, June 8, 1908, for the construction of two concrete abutments for a highway traffic bridge over the Moose Jaw Creek, east of Section 29, Township 16, Range 26 west of the 2nd meridian, south of the city of Moose Jaw, Sask. F. J. Robinson, deputy commissioner.

REGINA.—Tenders will be received until June 8th, 1908, for the construction of two concrete abutments for a highway traffic bridge south of Moose Jaw, Sask. F. J. Robinson, deputy commissioner.

Alberta.

EDMONTON.—Tender for iron posts will be received at the Department of the Interior up to the eighth day of June, 1908, for the furnishing of forty-five thousand iron posts, small size, and thirteen hundred iron posts, large size, for use on the survey of Dominion Lands, to be delivered in specified lots at Winnipeg, Man., Saskatoon, Sask., and Edmonton, Alta. P. G. Keyes, Secretary Department of the Interior.

EDMONTON.—Tenders for Court House, Edmonton, will be received up to June 13th, 1908, for the supplying of all plant, material, labor and performing all necessary work in the erection of a Court House in the city of Edmonton, Alta., and complete the following: 1st, all necessary excavation; 2nd, all concrete work for basement; 3rd, all stone and brick mason.v, concrete floors and roofing, together with certain woodwork; 4th, the supplying of all structural steel. John Stocks, Deputy Minister of Public Works.

British Columbia.

VICTORIA.—Tenders, sealed, endorsed and addressed to the undersigned, will be received up to 4 p.m. on Monday the 15th June, 1908, for supplying and laying certain steel rivetted pipe, also the supplying and installing in the Yates Street pumping station of two electric-driven power pumps. W. W. Northcott.

CONTRACTS AWARDED.

New Brunswick.

MONCTON.—Tenders for the construction of sewers on High, John, St. George and Cameron Streets have been made as follows: E. A. Wallberg, $6,351.50 for John Street, and $1,778 for the others. L. Devencer, Halifax, $1,717.10 for High, Cameron and St. George, and $7,224 for brick sewer on John Street. Amos Govang for brick sewer, $7,320.50. Docity T. LeBlanc, brick sewer $6,762; pipe sewer, $1,775.36. Daniel Gotro, $2,290.60 for pipe sewer. T. M. LeBlanc, brick sewer, $9,009.60. August F. Govang, for brick sewer, $7,816; pipe sewer, $1,780.10. The tender of E. A. Wallberg for the High, St. George and Cameron Street sewers was accepted and that of L. Devencer for the pipe sewer.

Quebec.

MONTREAL.—At a recent meeting of the Water Committee the awarding of contracts for various small supplies were as follows: Tenders were received for twenty, thirty, and sixteen-inch valves, and the following contracts were awarded:—Smiley & Fisher, three 30-inch gate valves, at $425; and two 20-inch valves at $165; Drummond, McCall & Co., two 16-inch gate valves at $78.50; Canadian Fairbanks Company, one 30-inch check valve, at $582, and one 30-inch flanged end valve at $6.30.

Ontario.

BRANTFORD.—The City Council awarded contracts to Ruhter & Caswell for concrete curbs at 20 cents per foot; to

Mickle-Dyment & Co. for lumber, and to James Reid, 22 South June Street, Dayton, Ohio, for sewer extensions.

COBOURG.—Tender for Cobourg Harbour Breakwaters will be received until Monday, June 29, 1908, for the construction of two breakwaters at Cobourg, Northumberland County, Ont.

GUELPH.—The contract for the construction of a bridge on Eramosa Road has been awarded to the Western Bridge & Equipment Company at $6,400 for steel superstructure. The other tenders were as follows: Conn & Co., $9,505 for reinforced concrete; J. A. Legrand, $9,732 for reinforced concrete; Jenks-Dressel Co., Sarnia, $8,670; Ontario Bridge Co., $8,350; Stratford Bridge & Iron Co., $9,500.

TORONTO.—The following companies' tenders have been accepted for fuel:—Milne's Coal Co. Hard coal, large egg, small egg, stove and nut sizes, per ton $6.40 from June 1st to September 1st, 1908, and $6.70 from September 1st, 1908, to May 31, 1909. Grate coal, best cannell, per ton, $7. Blossburgh coal, per ton, $6. Pine, per cord, long $5.90; cut and split, $6.40. Standard Fuel Company. Straitsville soft coal, lump size, per ton, $4.40. Soft coal, slack, Pittsburg or Reynoldsville, per ton, $3.24; Pocahontas, semi-bituminous, smokeless coal, per ton, $5.85. Hardwood, per cord, long, $6.80; cut and split, $7.40. Slabs, per cord, long, $4.60; cut and split, $5.50.

PORT ARTHUR.—The Nepigon Construction Company has the contract for the 80 mile section of the Transcontinental Railway east of Nepigon. In order to get in material and supplies for the work, they are building a narrow gauge steam tramway of 18 or 20 miles over the portage between the lakes, up which they will operate a line of steamers. They are at present employing 200 men upon these preliminary operations, but this force will be increased to about 2,000 in the course of a few weeks.

TORONTO.—The Gutta Percha and Rubber Manufacturing Company have been awarded the contract for a supply of hose for the high pressure fire system as follows: 4,000 feet of 3½-inch eureka, four-ply cotton rubber-lined hose at $1.68 per foot; 3,500 feet of 2½-inch paragon, three-ply cotton rubber-lined hose, at 95 cents per foot, and 500 feet of 2-inch eureka mill, cotton rubber-lined hose, at 43 cents per foot. The Canadian Rubber Company of Montreal will supply 1,500 feet of 2½-inch keystone, wax and gum treated fire hose, at 95 cents per foot.

WATERLOO.—Mr. E. Dermul received the contract for concrete sidewalks. The following tenders were received: John Schuetz, Berlin, 9¾ cents per sq. ft. E. Dermul, walk, 9c. per sq. ft.; driveways, 10c.; street crossings, 12c.; extra filling, 55c. per cu yd. Moogk & Kumpf, walk, 10c. per sq ft.; driveway, 10c.; street crossings, 12½c.; extra filling, 55c. per cu. yd. Mr. Sprague, Wiarton, walk, 11c.; driveways, 12c. per sq. ft.; street crossings, 15c.

Manitoba.

WINNIPEG.—In view of the report of the storekeeper of shortage in the cement supply, the controllers recommend that 1,000 to 5,000 barrels be purchased from the Winnipeg Supply Company, at $2.76½ per barrel including sacks.

British Columbia.

VICTORIA.—The contract for the erection of additional buildings at the agricultural grounds was let by the association executive to DeRousie & Gibson. The buildings to be erected by this firm will be the restaurant, which will be built on the site of the old main building, the machinery and poultry halls north of the new main building and the stock judging pavilion west of the grand stand. The contract cost of these buildings will be in the neighborhood of $15,000.

LIGHT, HEAT, AND POWER.

Nova Scotia.

SYDNEY.—A special committee are considering the erection of an electric light station here.

Quebec.

MONTREAL.—Plans are being prepared for a new steam plant of 2,000 horse-power capacity for the Saraguay Electric & Water Company by Mr. Charles Brandeis, C.E., of Montreal. Tenders for the equipment of this plant will be issued shortly.

Ontario.

FORT FRANCES.—The announcement that President Roosevelt has permitted the passage of the bill to extend the time limit for the completion of the Rainy River dam at International Falls has raised many hopes here. It is now confidently expected that in another month or two, Mr. Backus will be in a position to have work resumed, and he is to be congratulated on the splendid fight he put up at Washington to secure the extension. There is no doubt but that the Ontario Government will give a still further extension in which to complete the work on this side of the river now that the obstacles at Washingon have been overcome.

NEW HAMBURG.—At a special meeting of the village council, held May 30th, a resolution was unanimously adopted authorizing the reeve to sign the Hydro-Electric Niagara power agreement to contract for 250 horse-power for the use of New Hamburg industries and municipal purposes.

TORONTO.—Mr. Alexander Dow, the electrical engineer of Detroit, who has been advising the Board of Control of Toronto with reference to the construction of the electric power distributing plant, has suggested the names of Messrs. C. B. Smith, Professor R. B. Owens, of McGill University, and L. A. Ferguson, of Chicago, as men to constitute the Advisory Board of Electrical Engineers to superintend the construction of the plant. Mr. Dow suggests the name of W. G. Chace of Smith, Kerry & Chace, as a suitable man for engineer in charge. In the event of it being necessary to engage Mr. Dow as an expert his annual fee will be $1,200 and his per diem allowance $50, not including railway expenses.

MISCELLANEOUS.

Nova Scotia.

SYDNEY.—A lengthy report of the engineer in connection with repairs to Caledonian Road, Lake Road, Senator's Corner, Bridgeport, and the harbour bridge, totalling about $2,500 was read recently.

Quebec.

MONTREAL.—Funds were voted at a recent meeting of the Finance Committee for new street pavements to the extent of three-quarters of a million dollars, which represents the bulk of the money available for this season's work. There has already been voted for new pavements the sum of $36,000, and this, with the amount already voted, represents $876,000. It is likely that in the course of a couple of weeks another two hundred thousand dollars will be voted, as the list of streets has not quite exhausted.

Ontario.

TORONTO.—In reporting to the Board of Control egarding the protection of the beach to the west end of Simcoe Park, the City Engineer stated that the best material would be mattresses loaded with heavy stone which would cost about $45,000, for the whole distance of 5,000 feet, between Lee Avenue and the breakwater. For the portion east of the breakwater, on which are erected fourteen houses, it would cost about $12,500.

TORONTO.—The value of the buildings for which permits were issued by the City Architect the first five months of this year was $3,616,825 less than the value of the permits issued in the corresponding period last year. The figures a year ago were $7,574,665, and this year $3,957,840. The value of the buildings for which permits were issued last month was $1,216,982, as compared with $2,557,964 in May, 1907, or $1,340,982 less this past month than in May, 1907. The number of buildings for which permits were issued, however, did not show a corresponding falling off.

TORONTO.—To heat all the buildings of Toronto University from one central heating plant is a large scheme which the university authorities are at present considering. The proposal is to erect this new plant near University College and convey the steam to the different buildings by means of underground pipes, protected by asbestos coverings. This would mean a large saving in cost to the university. It is estimated that four boilers would do the work which now requires fourteen. The new heating plant will cost in the neighbourhood of $250,000.

WELLAND.—The Ontario Iron & Steel Works have opened with a large force of men. The prospects for the future under the management of Mr. Lefevre are bright. Next week the rolling mills will be started.

Manitoba.

BRANDON.—The Brandon Generator and Carbide Company has been incorporated, William Platton being the managing director and Frederick Koester secretary-treasurer. The company has secured the services of W. C. Collins, formerly the head foreman of the manufacturing department of the St. Thomas Acetylene Manufacturing Company, Ltd., of St. Thomas, Ont., and it is the intention to immediately establish premises for the purpose of manufacturing gas machines and other supplies required in its business. At the present time the company will not commence the manufacture of carbide in Brandon, but in the meantime the carbide of the company will probably be purchased from Fernie, B.C.

WINNIPEG.—Notice is given that the Municipal Council of the City of Winnipeg intends to make extensive local improvements in the way of plank, and granolithic walks, cedar block and asphalt pavements and sewers.

British Columbia.

PRINCE RUPERT.—Now that active operations in construction work on this end of the Grand Trunk Pacific have been begun, the town has taken a move forward and business in every line has an upward tendency. Considerable building has commenced and preparations for more are progressing.

VANCOUVER.—Valuable orders are being placed in Vancouver for supplies for use on the Grand Trunk Pacific construction east of Prince Rupert on the Foley, Welch & Stewart contracts. The large sum of money already expended in Vancouver in connection with this big northern work is but a part of the expenditure that will follow when construction is well under way.

VANCOUVER.—The agreement between the city and British Columbia Electric Railway Company covering the use of the new bridges by the tram company, was formally signed yesterday. As soon as the ties are laid in place on the temporary bridge the company will proceed with the laying of tracks preparatory to abandoning its present trestle over the Westminster Avenue structure.

RECENT FIRES.

Peterborough.—Fire, from some unknown cause, broke out in Peterborough Cereal Company's works, and the three storeys of the mill part including machinery, were completely destroyed. The packing room adjoining was pretty well gutted, and the elevator part considerably damaged. Loss not yet estimated. There is an insurance of $535,000 on the stock and $5,000 on the building.

MACHINERY WANTED.

No. 12.—A subscriber wishes the name and address of the builders of what is known as "Fox's Water Arch," used in connection with stationary boilers.

No. 13.—The name of manufacturers or selling agents of firms making cable wire and hemp or manilla woven together. Cable for use on derricks lifting up to six tons. Contractor asks.

PERSONAL.

MR. W. B. HARPER has left to inspect concrete work for the C.N.R. at Portneuf, Que.

MR. W. W BENNY, of the C.P.R. engineering staff has removed from Ramsay, P.Q., to White River, Ont.

MR. HENRY FRY, P.S.L.C., Lemainus, B.C., has taken out a large party on survey work. They will be out all summer.

MR. A. L. FORD, B.A.Sc., has been appointed Government Inspecting Engineer on G.T.P. Railway from Winnipeg to Saskatoon.

MR. RODERICK J. PARKE, consulting engineer, Continental Life Building, Toronto, has returned after spending two months in Europe.

MR. U. W. CHRISTIE, B.A.Sc., has received an appointment on the staff of the Department of Interior, Ottawa, in the Dominion Astronomers Observatory.

MR. F. ROY HALL has been appointed traffic manager of the Duluth, Rainy Lake and Winnipeg road. Mr. Hall has had previous experience with the Wisconsin Central, C.P. and N.P.

MR. CHARLES WEST, manager of the Western Fireclay Products, Limited, is in Weyburn, Sask., completing arrangements for the beginning of construction of the company's large plant.

MR. T. KENNARD THOMSON, M. Am. Soc. C.E., consulting engineer, has taken new offices in the Hudson Terminal Building, 50 Church Street, New York. For years Mr. Thomson has been recognized as one of the leading engineers on structural steel work, caissons and heavy foundation work.

MR. WILLIAM McNAB, principal assistant engineer of the Grand Trunk Railway system, succeeds the late Mr. Walter G. Berg as president of the American Railway Engineering and Maintenance of Way Association. Mr. McNab has the honour of being the first member resident outside of the United States to hold the office of president. He is a charter member and was vice-chairman of the first committee on gradation (since called Roadway) of which he afterwards became chairman.

MESSRS. STEWART & McTAGGART is the name of a new contracting and engineering firm, with offices in the Federal Life Building, Hamilton, Ont. They will make a specialty of structural steel for all classes of structures, conveying machinery, rolling mills, steel works, foundries, cement plants, sugar factories, power houses and manufacturing plants in general. Both members of the firm are graduates of S.P.S., Toronto, and have had many years' experience in designing and constructing.

MESSRS. K. A. McKENZIE, B.A.Sc., R. E. W. Hagarty, B.A.Sc., C. R. Murdock and J. A. Walker, graduates; J. E. Gray and C. S. Cameron, undergraduates, have accepted employment with the Yukon Consolidated Gold Fields, Limited, or in other words, the Guggenheim Syndicate. These men, who are all from the engineering faculty of Toronto University, are the first Canadian engineers to be employed by the Guggenheims, who have always, up to the present, employed only engineers from United States colleges. They will be placed in charge of a section of the hydraulic mining which is so extensively carried on by the Guggenheims in the Yukon, and will be stationed about 15 or 20 miles from Dawson City.

MARKET CONDITIONS.

Montreal, June 4th, 1908.

Quite a heavy buying movement developed in the United States during the past few weeks, and it would seem as though consumers have reached the opinion that prices have about touched bottom. Accordingly, they have been covering their requirements over the three months, and, to some extent, over the four months of the year. The volume of enquiries has had the result of stiffening the ideas of some producers, an advance of 50c. per ton over last week's quotations having been asked in some cases. This has resulted, to some extent, in a cessation of buying, consumers not being yet prepared to place orders at higher than recent figures. On the whole, the situation is more hopeful, at present, than it has been at any time during the past six months.

The English market is still in a very unsatisfactory condition. Business for both home consumption and for export is on a limited scale and prices are slightly easier. During the week ending May 14th, according to the latest advices, there was a further decrease in stocks in store, but there is apparently a feeling that from this out production will exceed consumption and shipment. The corner in Cleveland warrants terminated recently and the market is now in a normal condition, but on restricted lines. Generally speaking, the outlook is not favorable and even good Scotch brands show a decline of a shilling a ton during the week.

The local demand continues fair, with some users, apparently, requiring as much iron as they did a year ago. The greater number, however, are well stocked and consumption is comparatively small. Sufficiently low prices are being made on local iron to capture the bulk of the orders but

there is, of course, a moderate tonnage of Scotch and English brands to regulate foundry mixtures.

Antimony.—The market is firm and sales are being made at 9½ to 10c. per lb.

Bar Iron and Steel.—Bar iron, $1.90 per 100 pounds; best refined horse-shoe, $2.15; forged iron, $2.05; mild steel, $1.95; sleigh shoe steel, $1.95 for 1 x ⅜-base; tire steel, $2 for 1 x ⅜-base; toe calk steel, $2.45; machine steel, iron finish, $2.20; mild steel, $2.05.

Boiler Tubes.—The market is rather lower, quotations being as follows:—2-inch tubes, 8c.; 2½-inch, 10½c.; 3-inch, 11½c.; 3½-inch, 15c.; 4-inch, 19½c.

Building Paper.—Tar paper, 7, 10, or 16 ounce, $2 per 100 pounds; felt paper, $2.75 per 100 pounds; tar sheathing, No. 1, 60c. per roll of 400 square feet; No. 2, 40c.; dry sheathing, No. 1, 50c. per roll of 400 square feet, No. 2, 32c.

Cement—Canadian and American.—Canadian cement, $1.70 to $1.75 per barrel, in cotton bags, and $1.95 and $2.05 in wood, weights in both cases 350 pounds. There are four bags of 87½ pounds each, net, to a barrel, and 10 cents must be added to the above prices for each bag. Bags in good condition are purchased at 10 cents each. Where paper bags are wanted instead of cotton, the charge is 2½ cents for each, or 10 cents per barrel weight. American cement, standard brands, f.o.b. mills, 85c. per 350 pounds; bags extra, 10c. each, and returnable in good condition at 7½c. each.

Cement—English and European.—English cement is steady at $1.85 to $1.90 per barrel in jute sacks of 82½ pounds each (including price of sacks) and $2.20 to $2.30 in wood, per 350 pounds, gross. Belgian cement is quoted at $1.75 to $1.85 per barrel in bags, and $2.05 to $2.20 per barrel, in wood.

Copper.—The market is steady at 14 to 14½c. per pound. Demand continues limited.

Iron.—Prices of pig-iron continue steady here, foreign markets being, however, weaker. The following are quotations for pig-iron now arriving:—No. 1 Summerlee, on cars, Montreal, $20.50 to $21 per ton; No. 2 selected Summerlee, $20 to $20.50; No. 3, soft, $19.50 to $20; Cleveland, $18.50, and No. 3 Clarence. $18; No. 1 Carron, $22 to $22.50; Carron special, $20.25 to $20.75; Carron, soft, $20 to $20.50.

Lead.—Trail lead is weak and prices are steady at $3.80 to $3.90 per 100 pounds, ex-store.

Nails.—Demand for nails is moderate, but prices are steady at $2.30 per keg for cut, and $2.25 for wire, base prices.

Pipe—Cast Iron.—The market shows but little change and prices are as follows:—$34 for 8-inch pipe and larger; $35 for 6-inch pipe; $36 for 5-inch, and $36 for 4-inch at the foundry. Gas pipe is quoted at about $1 more than the above.

Pipe—Wrought.—The market is quiet and steady at last week's range:—¼-inch, $5.50, with sixty-three 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. The discount on the following is 68 per cent. off for black and 58 per cent. off for galvanized; ½-inch, $8.50; 1-inch, $16.50; 1¼-inch, $22.50; 1½-inch, $27; 2-inch, $36; and 3-inch, $75.50; 3½-inch, $95; 4-inch, $108.

Spikes.—Railway spikes are in fair demand, $2.60 per 100 pounds, base of 5½ x 9-16. Ship spikes are steady at $3.15 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.

Steel Plates.—Demand is good, and the market lower. Quotations are:—$2.25 for 3-16, $2.20 for ⅛, and $2.15 for ¼ and thicker, in smaller lots.

Tar and Pitch.—Coal tar, 4 per barrel of 40 gallons, weighing 575 to 600 pounds; coal tar pitch, No. 1, 75c. per 100 pounds, No. 2, 65c. per 100 pounds; pine tar, $4.35 to $4.50 per barrel of about 280 pounds; pine pitch, $4.25 per barrel of 180 to 200 pounds.

Tin.—The market is steady at 33½ to 34c. per pound.

Tool Steel.—Demand is light, but the market is firm. Base prices are as follows:—Jessop's best unannealed, 14½c. per pound, annealed being 15½c.; second grade, 8c., and high-speed, "Ark," 60c., and "Novo," 65c.; "Conqueror," 55 to 60c.; Sanderson Bros. and Newbould's "Saben," high-speed, 60c.; extra cast tool steel, 14c., and "Colorado" cast tool steel, 8c., base prices. Sanderson's "Rex A" is quoted at 75c. and upward; Self-Hardening, 45c.; Extra, 15c.; Superior, 12c.; and Crucible, 8c.; "Edgar Allan's Air-Hardening," 55 to 65c. per pound.

Zinc.—The market is unchanged, at 5¼ to 5½c. per pound.

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Toronto, June 4th, 1908.

At last what has been long foreshadowed is announced in telegrams of yesterday from Pittsburg and Cleveland. We quote one of these, from Cleveland, June 2nd:—"A cut of $4 a ton in bar steel went into effect to-day. The rumor of this cut, by authority of the bar steel manufacturers in New York yesterday was confirmed by John R. Scott, manager of the Carnegie Steel Company, here to-day. The new price goes into effect at once, but will affect only manufacturers' stock. The cut is based upon the Pittsburgh rate of $1.60 per hundred pounds. The new price is $1.40 per hundred." An official statement by the United States Steel Corporation shows a large expansion in orders for finished steel, following the heavy demand for pig-iron. It is, however, true that many manufacturers and merchants in lumber, steel, etc., are playing a waiting game, and that many mills are at half-time. The Baldwin Locomotive Works have only 5,000 men at work out of 18,000 on the usual pay-roll.

In Ontario, business is picking up slowly, and very few are buying with freedom. Stories come from the Prairie Provinces of large orders for dry goods and other merchandise, suddenly given by telegram. But a western merchant, especially if a novice, takes fire more quickly than a seasoned buyer, and may be the better of some wise restraint. Contractors in Toronto are fairly busy in some directions. Prices of structural materials are, as a rule, maintained. Some days must elapse before the effect of the reduction of steel prices, announced from Pittsburg, shows itself in Canada.

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

American Bessemer Sheet Steel.—Fourteen-gauge, $2.45; 17, 18 and 20-gauge, $2.60; 22 and 24-gauge, $2.65; 26-gauge, $2.80; 28-gauge, $3.

Antimony.—Not a great deal doing, 9½ to 10c. is present price. Crude material advancing.

Bar Iron.—$2 base, from stock to the wholesale dealer.

Beams and Channels.—In view of the decline in steel bars announced from Pittsburg, prices here may be reduced. Meantime they are:—$2.50 to $2.75, according to size and quantity; if cut, $2.75 to $3; angles, 1¼ by 3-16 and larger, $2.55; tees, $2.80 to $3 per 100 pounds. Extra for smaller sizes of angles and tees.

Boiler Plates.—¼-inch and heavier, $2.50. Fair supply, prices steady. Boiler heads 25c. per 100 pounds advance on plate.

Boiler Tubes.—Demand limited. 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, $15.30; 4-inch, $19.45 per 100 feet.

Building Paper.—Plain, 32c. per roll; tarred, 40c. per roll. Orders are of a limited character.

Bricks.—Common structural, $9 to $10 per thousand, wholesale, and the demand is quite brisk. Red and buff pressed are worth, delivered, $18; at works, $17.

Cement.—Price of Canadian makes to the dealer in 1,000 barrel lots and up is $1.80, in cotton bags, on car, Toronto. Retail price is $2 per barrel, 350 pounds. The quantity delivered from mills is much larger than in 1907.

Copper, Ingot.—Believing that consumption must increase, holders show much firmness. Consumption has greatly increased in Europe. Business here quiet; price, 13¾c. for large purchases and 14¼c. for small.

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

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

Felt Paper—Roofing Tarred.—Market steady at $2 per 100 pounds. A good many small orders.

Fire Bricks.—English and Scotch, $32.50 to $35; American, $25 to $35 per 1,000. Demand continues fair.

Fuses—Electric Blasting.—Double strength, per 100, 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. Bennett's double tape fuse, $6 per 1,000 feet.

Galvanized Sheets—Apollo Brand.—Sheets 6 or 8 feet long, 30 or 36 inches wide; 10-gauge, $3.25; 12-14-gauge, $3.35; 16, 18, 20, $3.50; 22-24, $3.70; 26, $3.95; 28, $4.40; 29 or 10¾, $4.70 per 100 pounds. Moderate supply.

Iron Pipe.—Black, ¼-inch, $2; ⅜-inch, $2.25; ½-inch, $2.72; ¾-inch, $3.68; 1-inch, $5.28; 1¼-inch, $7.20; 1½-inch, $8.64; 2-inch, $11.50; 2½-inch, $18.40; 3-inch, $24.15; 3½-inch, $30.40; 4-inch, $34.55; 4½-inch, $38, 5-inch, $43.50; 6-inch, $56. Galvanized, ¼-inch, $2.85; ⅜-inch, $3.05; ½-inch, $3.57; ¾-inch, $4.83; 1-inch, $6.93; 1¼-inch, $9.45; 1½-inch, $11.34; 2-inch, $15.12.

Lead.—The market may be described as firm, but quiet; quotation, $4.

Lime.—In plentiful supply and moderate movement. Price for large lots at kilns outside city 21c. per 100 lbs. f.o.b. cars; Toronto retail price 35c. per 100 lbs. f.o.b. car

Lumber.—Pine is in moderate supply, and the demand limited. Price of culls lower, as noted below. Dressing, we quote, $32 to $35 per thousand for usual lengths (12, 14, and 16 ft.) and stock sizes of boards, and $38 to $40 for special lengths, common stock boards, as to grade, $24 to $28; culls, $20. Southern pine and Norway pine are somewhat easier. Hemlock moves more freely and quotes at $19 to $21.50, according to size. Much spruce comes from the East and is in better demand; the price asked for flooring is $25 wholesale and $28 retail. Shingles, B.C., in more active demand, retailing at $3.75 per thousand. Laths are quiet, No. 1 quote at $4 on track, No. 2 at $3.50.

Nails.—Wire, $2.55 base; cut, $2.70; spikes, $3.15. No very active movement.

Pitch.—Fair demand at 75c. per 100 lbs.

Pig Iron.—The Middlesboro' corner, which has lasted a number of weeks, is broken, and prices in England shrank for a time, but are becoming normal. Business here is quiet and of small volume. Summerlee quotes:—No. 1, $25.50; No. 3, in car load lots, $22 to $23 here; Glengarnock, $25.50; Clarence. No. 3, $19.50 to $20; No. 1 Cleveland, $20 to $22.

Steel Rails.—80-lb., $35 to $38 per ton. The following are prices per gross ton; Montreal, 12-lb. $45, 16-lb. $44, 25 and 30-lb. $43.