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THE EXAMINATION OF ASPHALTIC ROAD MATERIAL

The engineer or contractor engaged in the work of laying roadways of material from bituminous origin will be interested in a description of a simple method of examining such materials and ascertaining their comparative composition. The materials of this nature which come to the contractor to be used as road materials are:—

Petroleums and petroleum products.
Malthas.
Asphalts.
Tars.
Bituminous aggregate, including rock asphalts, etc.

It is usual to submit the material to the following tests, viz.:—

Water.
Specific gravity.
Volatilization at 163°C.
Bitumen soluble in carbon disulphide.
Bitumen insoluble in 86°B* paraffin naphtha.
Fired carbon.

The apparatus required to make an examination of this nature would include a sensitive balance with weights (Metric), glass plate, desiccator, small stool, glass beaker, hydrometer or small glass flask, thermometer, drying bath, Gooch crucible, funnel, flask, with side arm, asbestos felt, Bunsen burner, platinum crucible, Sulphuric acid.

In estimating the moisture, 3 grams of the asphalt or other material are spread over the surface of a clean glass plate, which is of such size as to allow being placed in a desiccator giving as large an area as possible. Sulphuric acid is poured into the lower portion of the glass and the material enclosed for about one hour. The asphalt is removed from the drying dish and reweighed with as much speed as possible, allowing for accuracy. The loss in weight represents the enclosed moisture which has been absorbed by the acid lying below it. To reduce the moisture to a percentage basis, is, of course, a simple application of proportion; supposing the loss to be 0.097 gram. then 3.000 : 97 = 100 : x.x. = % moisture.

To determine the specific gravity of a sample, one or more methods may be used, depending on the sample being solid, thin liquid, thick or viscous fluids, or semisolids.

If the sample is solid or of sufficient stability to remain in definite form it is first weighed on the balance pan, such weight being represented by A. The small stool should be so constructed as to fit over the balance pan, allowing a free use of the same, as shown in Fig 1. The sample is suspended from the balance beam by a thin silk thread (for extreme accuracy the thread may be weighed and allowed for, this being well in the capabilities of a good balance). The beaker is filled about two-thirds with water, and for accurate results the water should be distilled and recently boiled, but allowed to become to the room temperature while covered.

The sample is again weighed while suspended, and the difference in weight represents the weight of an equal bulk of water B. The specific gravity of the sample would then equal $\frac{A}{B}$

*Baume.

To determine the specific gravity of a liquid, the balance may be employed with equal results to those obtained by accurate hydrometers. A small glass flask with a permanent mark made on the neck, is counterpoised by a weight on the balance, the weight of a volume of distilled and recently boiled water is ascertained, the flask is emptied, dried and filled with the sample, the mark on the neck being used to fill the flask with equal volumes. After the weight of the sample is secured, the calculation is made as above. The specific gravity is usually calculated to the third decimal place.

The substance should be treated to a heating of 163°C (325°F.) to ascertain the loss through such a condition.

This test is not made on tars, the distillation test being used to ascertain the loss on materials of this nature.

An oven as shown in Fig. 2 is the favorite in many laboratories in the United States, but any form of drying

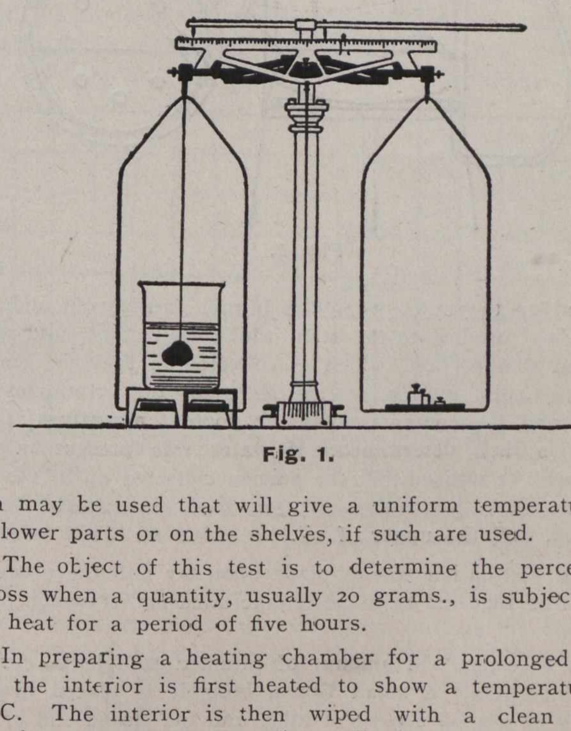

Fig. 1.

bath may be used that will give a uniform temperature in the lower parts or on the shelves, if such are used.

The object of this test is to determine the percentage of loss when a quantity, usually 20 grams., is subjected to this heat for a period of five hours.

In preparing a heating chamber for a prolonged heating, the interior is first heated to show a temperature of 163°C. The interior is then wiped with a clean cloth, removing any grease or other adhering material. The material being weighed is placed in a small copper saucer, when the door is closed, and the temperature of 163°C. maintained. A slight variance of two or three degrees at times will make no difference, should the gas pressure or other causes alter the conditions.

At the close of the time allowance, the sample is removed, and allowed to cool in a desiccator. If many samples are to be examined it is an economy to have the oven of such dimensions that several samples may be handled at the one time.

To put a sample of tar to this test, a retort of about ¾ litre capacity is used. The substance is distilled at such a rate that 250 cubic centimetres (c.c.) will deliver about 50 drops per minute. This distillate is collected in weighed glass graduates, the weights of which have been determined beforehand, and the weight marked on to the glass in some secure manner. From the specific gravity of the tar the weight of 250 c.c. is calculated and this amount after warming to liquefy, if necessary, is poured into the retort and the opening closed by a cork bored to receive a thermometer. A cold, wet towel may be wrapped around the stem to serve as a condenser. The tar should be heated gradually, and if crude, care should be taken to prevent the material foaming over. When the thermometer registers 110°C. the graduated glass is replaced by another, the towel is removed, and an asbestos hood placed over to prevent radiation. The method of making a hood is shown in Fig. 3. The receiving graduate is changed at 170°C. after melting down by very gentle heat, any solid material that has formed on the inner side of the stem. The next collection is made until the thermometer indicates 270°C., using as many graduates as may be necessary without allowing any to become filled above the mark. The last portion is

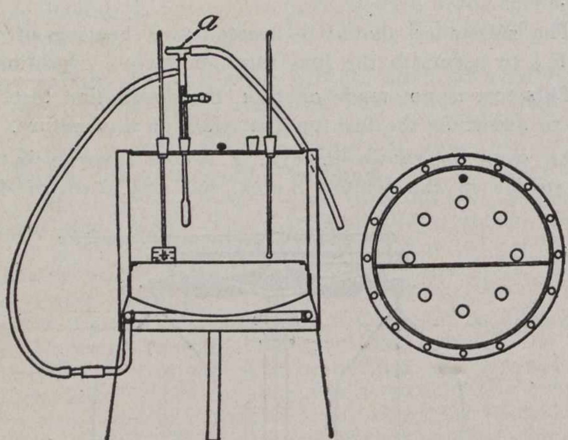

Fig. 2.

collected up to 315°C. when the burner is removed and the gentle heat applied to the stem which melts any solid matter from this portion, which is collected in the last graduate. Any solid matter on the sides of the graduates is melted and the contents cooled to room temperature, their weight is then determined. If water was present in the tar, it will be noticed that the portion collected up to 110°C., separates into two layers, the lower of ammoniacal liquor or water, and the upper of oil.

The distillation test is made upon tar and tar products when it is required to make a determination of water present.

To ascertain the amount of bitumen soluble in carbon disulphide (CS_2) a small Gooch crucible is placed in the opening of a good sized test tube, and the closed end of the tube drawn out and opened. In place of fitting a tube specially, a deep thistle funnel could hold the crucible. Whichever support is chosen, the stem is forced tightly through a cork or rubber stopper which closes a conical flask with a side delivery tube.

Some asbestos felt (amphibole asbestos) is cut with clean scissors into small pieces and shaken up with just sufficient water to pour easily. The crucible is filled with the suspended asbestos which is allowed to settle for a few moments. A light suction is then applied by means of an aspirator, through the side delivery tube of the flask, to draw off the water and leave a firm matt of asbestos in the crucible. More of the suspended material is added and the operation repeated until a dense matt of felt is formed. It should be washed several times and drawn firmly against the crucible, which is then removed to a drying oven, and then ignited to a red heat over a Bunsen burner, cooled in a desiccator and weighed.

From 2-3 grams of bitumen or 8-10 of an asphalt tapping or rock asphalt is now placed in the flask, the weight of which is known. One hundred c.c. of C.P. CS_2 is poured into the flask in small portions, with continual agitation until the lumps disappear. The flask is corked, and set aside for 15 minutes, and the solution decanted through the felt without suction. At the first indications of any sediment coming through, the operation is stopped and the filter allowed to draw. A small amount of CS_2 is used to wash down the side of the flask, after which the precipitate is brought on the felt, and any adhering material removed with a feather from the flask. The contents of the crucible are washed with CS, until the washings run colorless. The crucible and contents are dried in the air bath at 100°C. for 20 minutes, cooled in a desiccator, then weighed. The total weight of insoluble material may include organic and mineral matter. The former is burned off at a red heat leaving the mineral matter or ash which may be weighed and separated or noted, if necessary. The difference between the total weight and the weight of insoluble matter equals the bitumen soluble in carbon disulphide. When difficulty in filtering is experienced, as when Trinidad asphalt is present in quantities, allow to settle for more than 15 minutes.

To determine the bitumen soluble in paraffin naphtha, the above process is practically duplicated with 100 c.c. of 86°B. paraffin naphtha in place of the carbon disulphide. If difficulty is experienced in dissolving the material a rounded glass rod will be found convenient to break the small particles. Not more than one half of the naphtha should be used until the sample is broken up, the balance is then added, the flask twirled a moment or two, then corked and allowed to stand for 30 minutes.

The difference between the material insoluble in CS_2 and in naphtha is the bitumen insoluble in the latter.

In ascertaining the fixed carbon, one gram of the sample is placed in a small platinum crucible and a cover tightly fitted on. It is placed 6-8 centimetres above a Bunsen burner with a flame at least 20 centimetres high. This determination should be made in a position free from drafts. After the lapse of a few minutes the crucible is moved to a desiccator and when cool is weighed. After this has been noted, it is placed in an inclined position over the burner until nothing but ash remains. The weight of ash remaining is deducted from the weight of the residue made after the first ignition of the sample. This gives the weight of the so-called fixed carbon, which is calculated on a basis of the total weight of the sample.

To lay down specifications as to a good asphalt would be somewhat of a difficult problem, as general opinion varies somewhat on this point. The analysis of a good refined Maltha reads as follows:—

	Per cent.
Water and volatiles	.09
Total bitumen	98.33
Ash	1.58
	100.00
Bitumen composed of petrolene	75.15
Bitumen composed of asphaltene	24.85

Specific gravity 1.050.

The analysis of a good California asphalt reads:—

	Hard Bitumen. Per cent.	Maetha. Per cent.
Total bitumen soluble in CS_2	99.10	99.68
Silica and clay	0.36	0.20

An average analysis of crude Venezuela asphalt was:

Bitumen	66	per cent.
Water	31	"
Mineral matter	1	"
Organic matter not bitumen	2	"
	100.00	per cent.

This asphalt is softer than that which comes from Trinidad.

A Cuban asphalt analysis reads:—

Pure bitumen	70	per cent.
Foreign matter	24.50	"
Water	5.50	"

This sample came from the mine known as "Angela Elmira," the same being situated about five miles from the town of Bejucal in the Province of Habana.

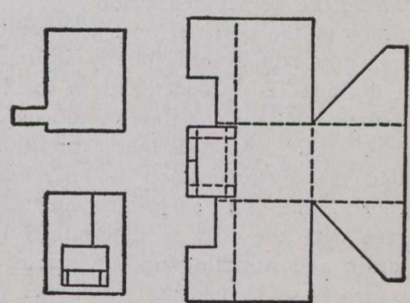

Fig. 3.

The following characteristics have been specified regarding mineral oils to be used as dust preventives or road preservatives:—

Specific gravity from 0.986—0.972 at 60°F.

Shall contain not less than 70 per cent. pure liquid asphaltum. Shall not contain over 2 per cent. water or foreign matter. Loss in weight on heating to 163°C. shall not be over 35 per cent.

Must be soluble in carbon disulphide to the extent of 98 per cent., and in 88° naphtha to at least 88 per cent.

STATISTICS OF THE LUMBER USED IN CANADA LAST YEAR.

Statistics of the lumber used during the past year have been received from 162 companies. consisting of the agricultural implement and vehicle manufacturers of Canada in six provinces, by the forestry branch of the department of the interior. 76,474 feet of lumber were used worth $2,513,265 or an average cost of $32.86 per thousand. Ontario used nearly 90 per cent. of the total for the Dominion. Quebec purchased 6 per cent.; Manitoba, 4 per cent., and Nova Scotia, New Brunswick and Prince Edward Island used very small amounts.

ANOTHER BIG RIVER IN CANADA.

The Porcupine river is a tributary of the Yukon. It has a tributary known as the Black Crow. Until a month or so ago no one believed that the Black Crow was more than twenty or thirty miles long. It is now known to be hundreds of miles long.

The discoverers are the surveyors delineating the international boundary in the far north. The last word received from them was that they had traversed 300 miles of the Black Crow. Access to the Arctic Ocean will be rendered much easier from the northern portion of Canadian territory.

DETERMINATION OF COST OF ALTERNATE PROPOSED DRAINAGE SYSTEMS.*

The installation of a drainage system and the fixing of its capacity is a matter of economics as well as engineering, for the homely question "Will it pay?" is the true criterion by which to judge the merit of any project.

It is especially desirable when planning for drainage to determine the proportionate costs of systems of different capacities in order to judge whether the drains should be built large enough to remove all rainfalls without being surcharged or whether expenses should be cut down by building them smaller and consequently apt to be flooded more or less frequently. Evidently the actual design of systems of different capacities in order to predict their cost would involve considerable labor and any method that will obviate the necessity of entering into the details of design will prove extremely helpful.

It is such a method that I intend to set forth; one whereby the cost of draining any district may be approximated without actually designing a system of drains. Naturally no account can be taken of any special peculiarities or difficulties of construction; neither is it my intention to enter into any discussion of the costs of various classes of drain construction, for that is too long a story, but it will be assumed that the costs of drains of various diameters under the average local conditions are known or that sufficient data to determine them are available.

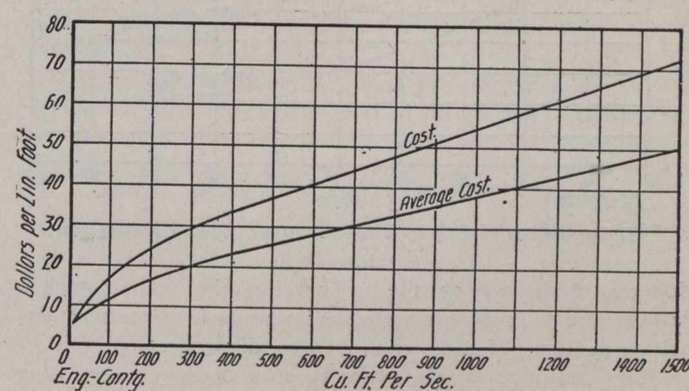

Fig. 1—Relation of Cost and Capacity of Concrete Storm Water Drain on Grade of 1 in 1000 in New York City.

The total cost of any drain may then be considered as a function on the length and diameter, but, as the diameter is dependent upon the grade of the drain and the required capacity the function really involves three variables: length, grade and capacity. The relations of two of these can be expressed quite simply; the cost will vary directly with the length and the capacity will vary inversely as the square root of the grade, but, the relation of cost to capacity is exceedingly complex. In the first place the cost is determined in no simple manner by the diameter and in the second the diameter determines the capacity in an extremely complex fashion, as those who are familiar with Kutter's formula know.

It is, therefore, hopeless to try to find any algebraic expression that will represent the dependency of cost upon capacity and a graphical method must be employed. This can easily be done by constructing a curve, the ordinates of which will be the cost per lineal foot of drains whose capacity on some one grade will be the corresponding abscissae.

*Abstract of article entitled "The Calculation of Runoff and the Cost of Drainage," by Carl H. Nordell, "Cornell Civil Engineer."

Such a curve is shown in Fig. 1, the ordinates are the costs in dollars per lineal foot of drains whose capacities in cubic feet per second on a grade of 1 ft. in 1,000 ft. are the respective abscissae. The costs were calculated from a series of concrete sewer sections using the prices of material and labor in the vicinity of New York city and naturally would not hold for dissimilar sewer sections or even similar sections in other localities. From such a curve the cost of carrying the water on any grade can be obtained by simply converting the given discharge to the corresponding discharge on the grade to which the prices on the curb refer. For instance the cost of carrying 1,000 cu. ft. per second on a grade of 4 ft. in 1,000 ft. would be equivalent to the cost shown on the diagram for carrying

$$1000 \times \frac{\sqrt{1}}{\sqrt{4}} \text{ or } 500 \text{ cu. ft. per second.}$$

The value of such a cost curve is that it renders possible the determination of the cost of a large drain whose capacity steps up as it lengthens without necessarily establishing the lengths and diameters of its sections and calculating the cost of each separately. It is evident that such a drain is approximately funnel shape, but, instead of a gradual and constant transition from a small to a large diameter the changes of size are abrupt. Therefore the cost of such a drain would be approximately the same as a theoretical funnel shaped one of the same average diameter.

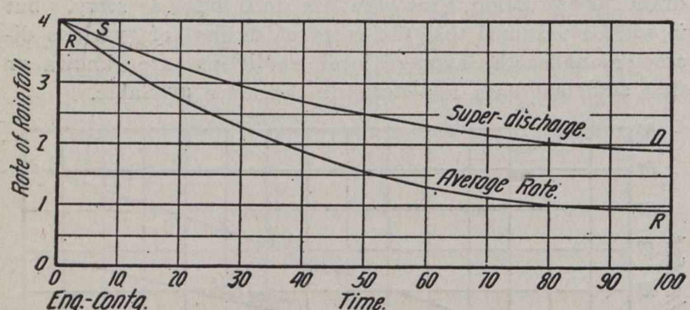

Fig. 2—Curve of Super-Discharge for Cost Calculation.

For example: If the capacity of a drain 3,000 ft. long with an average grade of one in one thousand increases uniformly to 200 cu. ft. per second at the outlet the average cost per ft. will be the average of the ordinates on the cost curve up to 200 cu. ft. per second. This can be found from the lower curve on the diagram, for it is drawn to represent at every point the average value of the preceding ordinates on the cost curve. The cost shown at 200 cu. ft. per second on this curve is $16 and therefore the total cost will be 3,000 times $16, or $48,000. One point to be noted in this connection is that the curve of average costs as drawn, represents the average cost from the smallest capacity shown. Clearly if the capacity of the sewer at its beginning is larger than this, the curve cannot be used directly, but must be employed to determine the average of the ordinates on the original cost curve between the capacity of the drain at its beginning and ending. If the average grade of the drain had been other than one in one thousand, the discharge of 200 cu. ft. per second would have to be converted to an equivalent discharge on the grade of one in one thousand as has been before described.

This method is suitable then, when the capacity of the drain is uniformly increased. This is practically the case when the territory drained is approximately proportional to the length of the sewer and the runoff proportional to the area, which latter assumption has been shown to be the best for designing drainage systems of limited capacity, but, it will not give good results when the runoff from small areas is considered to be proportionately higher than the runoff from large areas because then the capacity of the drain at its upper end is much greater in proportion to its length than it is at the outlet.

The cost of such a drain can be estimated by taking for the determining discharge not the actual discharge, but a super-discharge obtained by multiplying the total area drained by a rate of runoff which is the average of all the average runoff rates that would be used to determine runoff by the Rational Method. For instance, if RR in Fig. 2 represents the rainfall curve of average rates such as the Rational Method employs, a curve SD can be drawn so that it will represent at every point the average value of the preceding average rainfall rates. The curve SD can then be used to determine the super-discharge for cost calculation in the same manner that the rainfall curve of average rates is used to determine the actual discharge.

The accuracy of the costs arrived at depends upon how closely the area approximates the tacitly assumed conditions that the area drained is proportional to the length of the sewer at all points and that the time of concentration is proportional to the area. Although these conditions are never exactly fulfilled the approximation is near enough for all practical purposes, and it is surprising how closely the results will agree with the cost as determined by fixing the sizes of the drain and summing up the cost of the separate sizes. If the area is so shaped that the sewer palpably does not drain equal proportions with equal lengths it may be split up into sections where this condition will be more nearly true and closer final results achieved by considering each section separately.

It is now evident that the cost of any system of drains may be obtained without actual design. The first step is to lay out the lines the sewers are to follow. The small laterals will of course be pipe sewers and as their size is usually governed not so much by the amount of water to be carried as other considerations, their capacity will remain uniform throughout and their cost may be easily arrived at. The drainage area of each trunk sewer should now be determined together with the length of the sewer and the available amount of hydraulic grade. The time length of each drainage area may then be approximated and the super-discharge of actual discharge obtained for fixing the cost as has been described. The cost of each trunk sewer may then be determined and the entire cost of the system arrived at by addition.

In order to find the cost of a system of greater or smaller capacity it is not necessary to go through the whole process again, but it may easily be obtained in the following manner. If the total cost of the trunks is divided by their total length the result will be their average cost per foot, then by referring to the average cost curve the corresponding capacity can be obtained and used as an index to establish the cost of a larger or small system. If, for instance, the average cost of the trunk sewers is found to be $20 per ft. the corresponding capacity is 300 cu. ft. per sec. by the average cost curve in Fig. 1 and by doubling this capacity and finding the corresponding cost we will have $29, the average cost per foot of a system of twice the original capacity.

The method is likewise of great assistance in fixing the most economical run of the sewers as the cost of following many different routes with the trunks may be compared with but a slight expenditure of time; though naturally a number of important elements, such as depth of cut, character of soils, etc., would have to be allowed for separately.

The design of a drainage system is by no means a simple matter if conscientiously accomplished. It is in fact so complex and so ill-adapted to the use of rigid rules that many are prone to jump at the conclusion that almost any amount of latitude in fixing the sizes of drains is permissible, and as a consequence the subject does not receive the serious study that it should. This attitude is difficult to overcome particularly as the result of defective design is, as a rule, only an economic loss that is hard to prove and probably never realized by those on whom it falls. It is to be hoped—nay, it is not to be doubted, for conservation is becoming a watchword, that engineers will come to realize, and realizing prevent this economic waste.

FIELD CROPS IN CANADA.

The condition of field crops in Canada is presented in a bulletin of the Census and Statistics Office, and shows good averages for all provinces as well as for all crops. Fall wheat was hurt by the hard winter in Ontario, but fared better in Alberta. The estimated yield is 23.24 bushels for the former province and 27.89 bushels for the latter. The total estimated yield is 17,706,000 bushels. The condition of spring wheat at the end of July, 1911, was 90 for the whole of Canada, being 85 to 95 in the Maritime Provinces, 80 to 89 in Ontario and Quebec, 90 to 96 in the Northwest Provinces and 85 in British Columbia. Oats and barley have an average condition of 88 for Canada, 85 to 95 in the Maritime Provinces, 80 to 90 in Ontario and Quebec, 88 to 100 in the Northwest Provinces, and 87 to 89 in British Columbia. Rye, peas and beans range from 78 to 84 in Canada and buckwheat 81.85. Mixed grains have a condition of 86, which is 14 per cent. less than last year, and flax is 91, which is nearly 20 better. The average of corn for husking is 86 and of potatoes 85.64,—being in each case a little higher than last year. Potatoes, turnips and mangolds range from 81 to 85, or about the same as a year ago. Hay and clover and alfalfa are 80 to 83, which is a little lower in each case than last year. Corn for fodder has an average condition of 87, sugar beets of 79 and pasture of 79. The eastern provinces are lower than the figures quoted for the whole of Canada, and the western provinces are higher. The highest averages are given for Manitoba, Saskatchewan and Alberta. Sugar beets have a condition of 81 in Ontario and Alberta.

Compared with last year's crops in the Northwest Provinces, the condition of spring wheat in Manitoba south of the Grand Trunk Pacific Railway is 88 to 39, of oats 88.72 to 38.85 and of barley 85.16 to 34.92; and north of the same railway the condition is 92.21 to 77.42 for wheat, 90.71 to 72.90 for oats, and 88.95 to 50.84 for barley. In Saskatchewan south of townships 25 the condition of wheat is 90.19 to 69.33, of oats 88.27 to 61.64 and of barley 89.03 to 65.89; and north of townships 24 the condition of wheat is 98.22 to 67.69, of oats it is 95.35 to 63.88, and of barley 94.58 to 71.30. In Alberta south of townships 31 the condition of wheat is 93.89 to 24.93, of oats 95.28 to 20.43 and of barley 93.70 to 26.36; and north of townships 30 the condition of wheat is 97.84 to 71.55, of oats 97.95 to 65.68 and of barley 105.95 to 73.60.

The area of spring wheat in the Northwest Provinces this year is 1,500,000 acres more than last year and of oats 341,000 acres, but no increase is shown for barley.

The yield of hay and clover is estimated at 12,189,000 tons for Canada, being 1.43 tons per acre, and the largest yields for provinces are 4,736,000 tons in Ontario, 5,028,000 tons in Quebec, 254,000 tons in Prince Edward Island, 941,000 tons in Nova Scotia and 885,000 tons in New Brunswick.

THE ROAD BOARDS OF GREAT BRITAIN.

General Directions and Specifications Relating to the Tar Treatment of Roads.

(Continued from last week)

9. The quantity of tar used to coat 1 ton of stone should be approximately from 9 to 12 gallons, varying according to the sizes of the stone, the grade of tar used, the method of mixing and other conditions.

10. The tar-macadam after having been spread and levelled should be rolled into a smooth surface, but too much rolling should be avoided.

Less rolling is required than in the case of water-bound macadam.

A 10-ton roller is a suitable size for use in most cases, but good results can be obtained by using a 6-ton roller, and finishing with a 10-ton roller.

11. In order to get the best results from the use of tar-macadam, it is advisable to apply a coating of tar to the surface after the road has been used by traffic for several weeks. This tar should comply with the provisions of Road Board Specification for Tar No. 2, and should be poured or sprayed on the surface at a temperature of about 270 deg. Fahr.

12. Stone chippings, crushed gravel, coarse sand, or other approved material (free from dust), not larger than will pass through a ¼-in. square mesh, should be used for gritting in quantity not exceeding 1 ton for 400 to 350 super. yards if grit is used, and 1 ton for 200 to 250 super. yards if coarse sand is used.

Note.—These general directions are not intended to displace or to discourage the use of proprietary articles of which there are several of proved value.

ROAD BOARD SPECIFICATION, No. 3

General Directions for Surfacing With Pitch-Grouted Macadam.

1. Any road which is to be surfaced with pitch-grouted macadam should have a proper foundation or sub-crust of adequate thickness to bear the traffic likely to use it.

2. Before laying a new surface of pitch-grouted macadam, the thickness of the old crust, including foundations, should be ascertained by opening trial trenches at intervals, averaging about 150 yds., extending from the haunch of the road to the centre, such trenches to be made alternately on opposite sides of the road.

3. The thickness of the surface coating of pitch-grouted macadam when finished and consolidated by rolling should be 2½ in. to 3 in. (except on very light-traffic roads, when the thickness may be 2 in.) for single-pitch grouting, and from 4 in. to 4½ in. for the double-pitch grouting hereafter described.

4. In the case of naturally hard subsoils, not materially softened by infiltration of surface water, the total thickness of the road crust, including foundation, if any, after consolidation by rolling of the new pitch-grouted surface, should not under ordinary circumstances be less than 6 in. unless the subsoil is so hard as in itself to act as a good foundation, in which case the thickness of the road crust may be reduced to 4 in. In the case of clay or other yielding subsoils, the total thickness should not be less than 11 in.

5. The finished surface should have a cross-fall of about 1 in 32.

If the crust is not sufficiently thick at the crown to enable this cross-fall to be obtained with a new coating of the thickness above mentioned, then the old surface should be left intact and unscarified, and the thickness of the new pitch-grouted coating increased as far as may be necessary.

If the crust is of sufficient thickness for the purpose, the regulation of the cross-fall should be carried out by scarifying the surface and removing material from the crown to the sides previous to the application of the new coating. Material loosened by scarifying should be screened and all material finer than ½ in. should be thrown aside.

6. The aggregate of broken stone to form the new surface of pitch-grouted macadam should contain broken stone of approved quality, of which at least 60 per cent. must be broken to the size of 2½ in., and 35 per cent. to sizes graded from 2½ in. to 1¼ in. In addition to this 5 per cent. of chippings of the same stone, varying from ¾ in. down to ⅜ in., should be used for closing after the grouting with melted pitch.

7. For making pitch-grouted macadam the pitch used should comply with the Road Board Speecification for Pitch, its viscosity being altered to suit climatic and local conditions by varying the quantity of the tar oils as specified therein.

8. It is important that the pitch should not be poured if the surface of the stone is wet. The stone may be protected by tarpaulins, or, if wet, may be dried in situ by portable blowers or other means.

9. The quantity of pitch required to grout a single coating is approximately, for a consolidated thickness of 2 in., 1¼ gallons per yard super.; for 2½ in., 1½ gallons per yard super.; and for 3 in., 2 gallons per yard super.; but these quantities may vary with different materials, and care must always be taken to fill the voids adequately.

10. The aggregate after having been spread must be rolled down dry until the surface is formed, but without the addition of any small material.

11. The pitch, after being carefully melted, as described in Clause 18, must be raised to a temperature of 300 deg. Fahr. Clean, sharp sand must be heated on sand heaters to a temperature of 400 deg. Fahr. A dandy, or portable mixing vessel, is then to be filled with equal parts, by measurement, of the heated pitch and the hot sand, and the mixture, hereafter called the matrix, is to be kept well stirred while it is being emptied from the dandy or portable mixing vessel into pouring cans of from 2 to 3 gallons capacity, which are used for pouring matrix on to the roadway. Not only during the process of mixing, but afterwards, right up to the time of actual pouring, the matrix must be kept well stirred. The matrix prepared with pitch in the quantities specified in Clause 9 should be sufficient to fill the voids of the aggregate.

12. The final rolling should be commenced immediately after pouring the pitch matrix, and carried on rapidly before the matrix has time to set. The 5 per cent. of graded chippings should be spread over the grouted surface in part previously to and the remainder during the process of rolling. The traffic may be allowed on to the finished surface as soon as the surface has cooled to the normal temperature.

Double Pitch-Grouting

13. When the traffic is so heavy that a consolidated thickness of from 4 in. to 4½ in. of pitch-grouted macadam is required, it is desirable, in order to obtain the best and most economical results, to divide the coating into two layers, the bottom layer to be the thicker one and to consist of large stones, the two layers being rolled down, and grouted separately. Any local stone which can be procured cheaply may, if suitable in quality for foundation work, be used for the bottom layer graded from 3-in. gauge down to 2-in. gauge. No chippings are required for finishing the rolling of the bottom layer. The aggregate for the upper layer should consist of hard road stone of approved wearing quality, broken to 1½ in. gauge, and 5 per cent. of chippings of the same stone used for the upper layer, graded from ½ in. down to ¼ in., should be added before and during the process of rolling, and rolled down so as to form the finished surface of the road.

14. In pouring the pitch on the bottom layer the surface of the pitch should not be brought to the surface of the stone, but should lie about ½ in. below such surface, with the object of providing a key for the upper layer.

15. The materials and the methods of grouting and laying down in the case of double pitch-grouting, except when otherwise expressly stated, conform to the provisions of Clauses 7, 8, 10, 11 and 12.

16. The quantity of pitch required for double pitch-grouting is approximately, for a considerable thickness of 4 in., 3¼ gallons per yard super., and for 4½, 3½ gallons per yard super., but these quantities may vary with different materials, and care must always be taken to fill the voids in the surface coating adequately.

17. For the purpose of accurately ascertaining the proportions necessary for the matrix, it is essential that portable weights, scales and measures be provided, and all materials used in the preparation of the matrix should be accurately proportioned by weight or measurement.

Instructions for Melting the Pitch

18. The pitch boilers of from 2 to 3 tons capacity should be charged with pitch and about one-half of the proper proportion of tar oils. The fire should then be lighted, and thereafter a steady fire, with fire doors closed, should be maintained, when, in from four or five hours, the pitch should be thoroughly melted. A bright fire should be kept until the pitch reaches a temperature of 300 deg. Fahr., when the remainder of the oils should be added, and the mixture thoroughly stirred; the fire doors should then be opened and the temperature of the melted pitch permitted to fall to 250 deg. or 270 deg. Fahr. The pitch should then be ready for use, and in all cases should be thoroughly well stirred before being drawn off.

In the event of bad weather stopping the work of grouting, the fire door should be left open, the damper closed, and the temperature of the pitch allowed to fall to 200 deg. Fahr. It can be kept at this temperature for long periods with banked fires consuming 7 lb. of coke per hour.

It is recommended that a suitable Fahrenheit thermometer with metal protection should be at hand to indicate the temperature of the melted pitch. Whenever the weather is favorable for the recommencement of the work the pitch must be again raised to 270 deg. Fahr., by closing the doors and sharp firing.

It is desirable that the boiler should be kept air-tight when the pitch is being melted, by the use of airtight covers properly packed so as to make an airtight joint.

Note.—These general directions are not intended to displace or to discourage the use of proprietary articles, of which there are several of proved value.

ROAD BOARD SPECIFICATION, No. 4

Specification for Tar No. 1. General.

1. This tar is suitable for the surface tarring of roads.

As to the use of this tar for making tar-macadam, see "Road Board's General Directions for Surfacing with Tar-macadam."

Boiling

2. The tar should be applied as soon as the boiling point is reached, and over-boiling should be avoided. The desired temperature will be generally found in practice to lie between 220 deg. and 240 deg. Fahr. in the boiler.

Source of Tar

3. The tar shall be derived wholly from the carbonization of bituminous coal, except that it may contain not more than 10 per cent. of its volume of the tar (or distillates or pitch therefrom) produced in the manufacture of carburetted water gas.

Specific Gravity

4. The specific gravity of the tar at 15 deg. Cent. (59 deg. Fahr.) shall be as nearly as possible 1.19, but in view of the great variation in specific gravity of the tars produced in various parts of the country, the specific gravity may be as low as 1.16, or as high as 1.22, provided that in other respects it complies with the provisions of the specification.

Freedom From Water

5. The tar shall be commercially free from water—i.e., it shall not contain more than 1 per cent. by volume of water or ammoniacal liquor, which water or liquor (if present) shall not contain more ammonia, free or combined, than corresponds to 5 grains of ammonia per gallon (=70 milligrammes per litre) of the tar.

Phenols

6. On vigorous agitation for a quarter of an hour with twenty times its volume of water at 21 deg. Cent., (70 deg. Fahr.) the tar shall not impart to the water more than 5 grains of phenoloid bodies, reckoned as phenol, per gallon of water (=70 milligrammes per litre).

Tar From Gasworks

The provisions in the following Clauses 7, 8 and 9 apply to tar supplied direct from gasworks.

Source of Tar

7. The tar shall be solely the natural by-product of the manufacture of illuminating gas (coal gas with or without admixture of carburetted water gas) and shall have been subjected to no other or further treatment than may be necessary for the abstraction of water or ammoniacal liquor and light oils.

Fractionation

8. On distillation the tar must yield: below 170 deg. Cent., not more than 1 per cent., and between 170 deg. Cent. and 270 deg. Cent., not less than 16 per cent. and not more than 26 per cent. of distillate (exclusive of water).

Free Carbon

9. The free carbon shall not exceed 16 per cent. of the weight of the tar.

Tar From Tar Distilleries

The provisions in the following Clauses 10 and 11 apply to tar supplied from tar distilleries.

Fractionation

10. On distillation the tar must yield: below 170 deg. Cent. not more than 1 per cent. and between 170 deg. Cent. and 270 deg. Cent. not more than 26 per cent. of distillate (exclusive of water). The distillate shall remain clear and free from solid matter (crystals of naphthalene, &c.), when maintained at a temperature of 30 deg. Cent. for half an hour. The distillation shall be continued to 300 deg. Cent., and the residual pitch thus obtained shall not amount to more than 73 per cent. of the weight of the tar.

Free Carbon

11. The free carbon shall not exceed 16 per cent. of the weight of the tar.

Taking of Temperatures

12. The temperature during distillation shall be taken by a thermometer of which the bulb shall be opposite the opening to the side tube of the distillation flask, and the quantities of distillates and free carbon shall be stated in percentages by weight of the portion of tar submitted to distillation.

Dehydrated Tar.

13. A tar prepared by simple dehydration fulfilling the provisions of this specification may be used with satisfactory results in most cases, but tars from which the naphthalene has been extracted are superior for the purposes of surface tarring.

Note.—This specification is not intended to displace or to discourage the use of proprietary articles, of which there are several of proved value.

ROAD BOARD SPECIFICATION, No. 5.

Specification for Tar No. 2. General.

1. This tar is suitable for surface tarring, and is specially recommended for re-tarring, but if the heavier grades of the tar is used, care should be taken to apply it only when the road is dry and well warmed by the sun's rays, otherwise it will not flow freely.

As to the use of this tar for making tar-macadam, see "Road Board General Directions for Surfacing with Tar-macadam."

Boiling

2. The tar is to be applied as soon as the boiling point is reached, and over-boiling should be avoided. The desired temperature will be generally found in practice to lie between 260 deg. and 280 deg. Fahr. in the boiler.

Source of Tar

3. The tar shall be derived wholly from the carbonization of bituminous coal, except that it may contain not more than 10 per cent. of its volume of the tar (or distillates or pitch therefrom) produced in the manufacture of carburetted water gas.

If pitch be added to the tar in order to secure the specific gravity and proportion of residual pitch referred to below, the pitch so added must also have been derived from tar of the foregoing description.

If oil be added to heavy tar or pitch in order to secure the specific gravity and proportion of residue referred to below, the oil so added must be derived from tar of the foregoing description, and must be practically free from naphthalene and tar acids or phenols.

Specific Gravity

4. The specific gravity of the tar at 15 deg. Cent. shall be as nearly as possible 1.21, and in no case shall it be lower than 1.18, or higher than 1.24.

Phenols

5. On vigorous agitation for a quarter of an hour with twenty times its volume of water at 21 deg. Cent., the tar shall not impart to the water more than 5 grains of phenoloid bodies, reckoned as phenol, per gallon of water (=70 milligrammes per litre).

Fractionation

6. The tar shall be free from water, and on distillation shall yield no distillate below 140 deg. Cent., nor more than 3 per cent. of distillate up to 220 deg. Cent., which distillate shall remain clear and free from solid matter (crystals of naphthalene, etc.,), when maintained at a temperature of 30 deg. Cent. for half an hour.

Between 140 deg. and 300 deg. Cent. it shall yield not less than 15 per cent., nor more than 21 per cent. of the weight of the tar.

Free Carbon

7. The free carbon shall not exceed 18 per cent. of the weight of the tar.

Taking of Temperatures

8. The temperatures during distillation shall be taken by a thermometer, of which the bulb shall be opposite the opening to the side tube of the distillation flask, and the quantities of distillates and free carbon shall be stated in percentages by weight of the portion of tar submitted to distillation.

Note.—This specification is not intended to displace or to discourage the use of proprietary articles, of which there are several of proved value.

ROAD BOARD SPECIFICATION, No. 6

Specification for Pitch. General.

1. This pitch is suitable for pitch-grouting. See "Road Board's General Directions for Pitch-grouting."

Preparation

2. The pitch is obtained by softening the material known as commercial soft pitch, as specified below, by the addition of tar oils, also specified below.

Commercial Soft Pitch

Source of Pitch

3. The pitch shall be derived wholly from tar produced in the carbonization of bituminous coal, except that it may contain not more than 10 per cent. of pitch derived from tar produced in the manufacture of carburetted water gas.

Fractionation

4. On distillation the pitch shall yield:—

Below 270 deg. Cent., not more than 1 per cent. of distillate.

Between 270 deg. Cent. and 315 deg Cent., not less than 2 per cent. and not more than 5 per cent. of distillate.

Free Carbon

5. The free carbon should not exceed 22 per cent. of the weight of the pitch, but if it be found difficult or undulv expensive to obtain this quality of pitch, a quality containing as much as 28 per cent. of free carbon may be used with a reduced proportion of sand as filler.

Taking of Temperatures

6. The temperature during distillation shall be taken by a thermometer, of which the bulb shall be opposite the opening to the side tube of the distillation flask, and the quantities of distillates and free carbon shall be stated in percentages by weight of the pitch submitted to distillation.

Tar Oils. General

7. The tar oils to be used shall be derived wholly from tar produced in the carbonization of bituminous coal, or from such tar mixed with not more than 10 per cent. of its volume of tar produced in the manufacture of carburetted water gas.

Specific Gravity

8. The specific gravity of the tar oil at 20 deg. Cent. shall lie between 1.065 and 1.075.

Freedom From Naphthalene

9. The tar oils after standing for half an hour at 20 deg. Cent. shall remain clear and free frm solid matter (crystals of naphthalene, etc).

Fractionation

10. The tar oils shall be commercially free from light oils and water—i.e., on distillation shall yield not more than 1 per cent. of distillate below 140 deg. Cent.

The amount of distillate between 140 deg. Cent. and 270 deg. Cent. shall lie between 30 per cent. and 50 per cent.

Taking of Temperatures

11. The temperatures during distillation shall be taken by a thermometer, of which the bulb shall be opposite the opening to the side tube of the distillation flask, and the quantities of distillates shall be stated in percentages by weight of the oils submitted to distillation.

Proportions

12. The proportions by weight in which the pitch and tar oils are to be mixed shall be as follows:—

Pitch 88 per cent. to 90 per cent.

Tar oils 10 per cent. to 12 per cent.

Note.—This specification is not intended to displace or to discourage the use of proprietary articles, of which there are several of proved value.

RAIL-LESS STREET CARS.

The first rail-less street cars propelled by electricity to be used in England have just been installed by the City Council of Leeds. The system at present is an experimental one and is being closely watched with a view to its early adoption in other cities if successful.

The wheels of the new cars are fitted with rubber tyres and are attached to the overhead wires by a double trolley arm. The overhead equipment has cost about £1,250 per mile and the cost of each vehicle is about equal to that of an ordinary tramway car. The double trolley arm, acting on a swivel, permits of a liberal deviation on either side of the road, thus allowing the vehicle to wind in and out of the traffic when necessary. Each car is made to hold 28 passengers. Only one entrance is provided and the driver sits in front in charge of the controller and steering wheel and at the same time collects the fare from each passenger as they enter.

As there is no metal track to be laid down and kept in repair, the running cost of these cars is expected to be considerably less than that of the ordinary tramway cars. This type of car has been introduced to meet the requirements of certain outlying districts, which, owing to their thinly scattered population, could not maintain an ordinary tramway service with profit. In these cases, it is thought that the system of rail-less traction with its low cost of maintenance, can be advantageously employed both to the benefit of the tramway service and the community.

*Extract from Report of Depcrtment and Commerce.

AN ANALYSIS OF THE STRESSES IN GUY WIRES.*

W. M. Wilson

Some time ago the writer received an inquiry in regard to the stresses in steel wires such as are used for guys for steel stacks. Upon investigation he was unable to find any treatment of the subject and began an investigation which resulted in the following demonstration.

Steel stacks which are not self-supporting are usually supported by one or more sets of wires, each set consisting

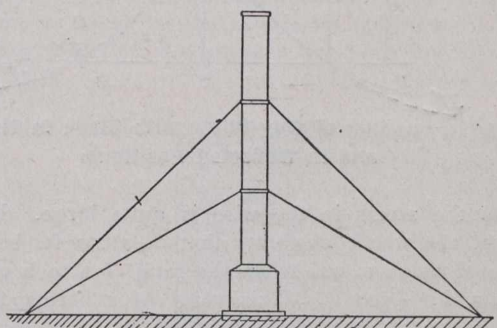

Fig. 1—Typical Arrangement of Guy Wires for Stack.

of four wires evenly spaced as seen in the plan. Such a stack is shown in Fig. 1.

been increased and that of BC decreased. The two acting together now exert upon the stack a horizontal force equal to the difference between the horizontal components of the stresses in the two wires. This force tends to return the stack to its original position and has been designated by the writer as the righting force. The guy wires produce this righting force when, and only when, the top of the stack moves out of the position which it occupies when no external force acts upon it.

It is evident that the less the initial stress in the wires the greater the displacement of the stack required to produce a given righting force, and also the lower the initial stress the greater the ratio of the righting force to the maximum stress in the wires. An analysis of the problem involves the determination of the relation existing between the four variables; initial stress in the wire; deflection of the stack, horizontal righting force, and the maximum stress in the wire. It was found that the mathematical relations between the quantities involved are so complex that the numerical solution of any specific problem would be impractical. The writer, therefore, undertook the solution of typical cases in order to get data from which curves could be platted for use in the solution of specific cases. The cases considered are those in which a = 100 ft. b = 50 ft., and a = 100 ft. b = 100 ft., (see Fig. 2) when the horizontal component of the initial stress in the wire had the following values: 1,020 lbs. per sq. in., 1,700 lbs. per sq. in., 3,400 lbs. per sq. in., 6,800

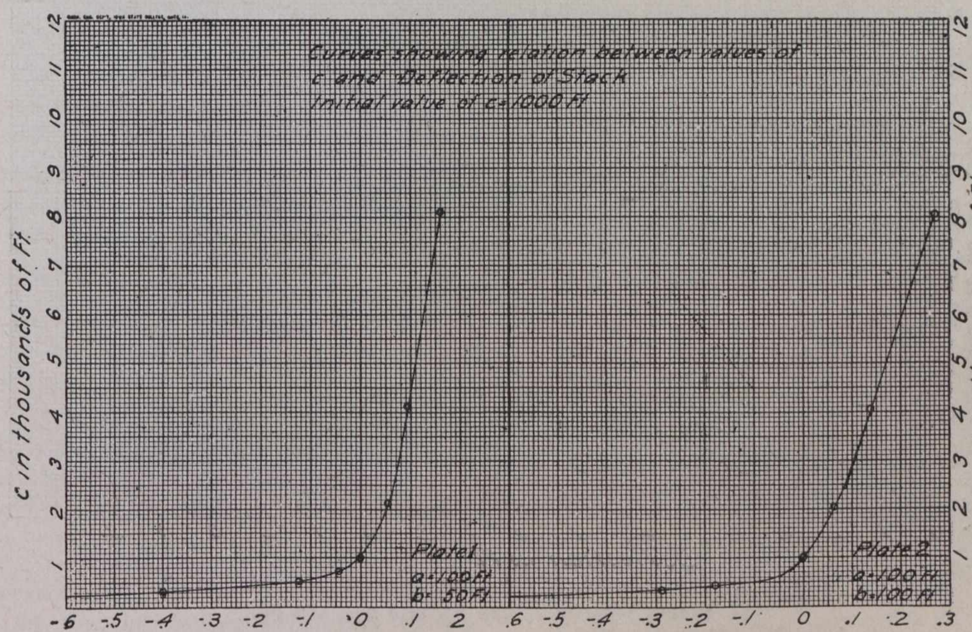

Fig. 3—Plates Showing Relation Between Values of "o" and Deflection of Stack.

Let OC, Fig. 2, represent such a stack and let AC and BC be two of the wires lying in the plane of the paper. With OC in a vertical position, and with no horizontal force tending to overturn the stack, the two wires AC and BC will assume the same form. Each will exert a force at C, but under the conditions assumed the horizontal component in AC will be just equal but opposite in direction to the horizontal component in BC, so that the two acting together will have a horizontal resultant equal to zero and will therefore exert no horizontal force upon the stack. Suppose that some external force such as the wind acts upon the stack and moves it to some new position such as OC′. AC now occupies the position AC′ and BC the position BC′. By inspection it is seen that the horizontal component of AC has

lbs. per sq. in., 10,200 lbs. per sq. in. and 13,600 lbs. per sq. in. If the length of the wire whose weight is equal to the horizontal component of the stress would correspond to values of c equal to 300 ft., 500 ft., 1,000 ft., 2,000 ft., 3,000 ft., and 4,000 ft. Plate 2 of Fig. 3, is for wires for which a = 100 ft. and b = 100 ft. It shows the relation between the deflection of the top of the stack and the resulting horizontal component of the stress in the wire. This curve was originally drawn for a wire having an initial value of c = 1,000 ft. but can be used for other cases in which a = 100 ft. and b = 100 ft. by properly shifting the origin. Plate 1 of Fig 3 is the corresponding curve for the case in which a = 100 ft. and b = 50 ft. The portions of these curves to the right of the origin are for the taut wire, and the portions to the left are for the loose wire. Plate 3 (Fig. 4) was derived from Plate 1, and Plate 4 (Fig. 5) from Plate 2, as follows: Consider two points on the curve of Plate 1,—one a certain distance to the right of the origin and the other an equal distance to the left. The value of the ordinates of these two points gives the horizontal components of the stresses in the wires, and their difference gives the righting force resulting from a deflection represented by the abscissae of the points chosen. In this way a number of points can be transferred from Plate 1 to Plate 3 and the curve on Plate 3 determined. This has been done for different values of the initial stress in the wire as indicated above for both Plates 3 and 4. The relation between righting force and deflection is given by the lower curves, and the relation between stress in the wire and deflection is given by the upper curves.

In the equation of a catenary, used in developing this method, all the quantities can be represented by lines. That is, if a catenary with a given value of c is drawn to a given scale, the same curve can be made to represent some other catenary by changing the scale of the drawing, but the value of c for the second catenary must bear the same ratio to the value of c for the first as the true value represented by any ordinate of the second catenary bears to the true value represented by the same ordinate of the first catenary. That is to say, while Plates 1 to 4 were originally drawn for cases

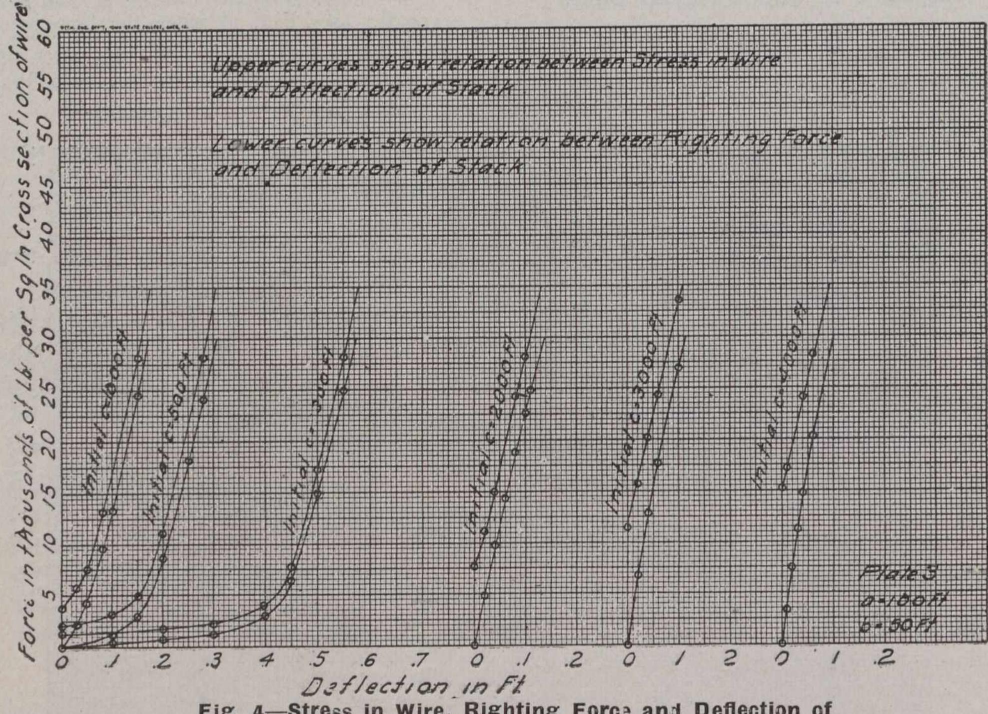

Fig. 4—Stress in Wire, Righting Force and Deflection of Stack, When a = 100 Ft. and b = 50 Ft.

in which a = 100 ft. b = 100 ft. and a = 100 ft. b = 50 ft., by properly changing the scale they will apply to all cases in which a = b and a = 2b. For example, if a = b equals n times 100 ft. the value of the maximum stress in the wire to be read from the curve would be allowable stress divided by n, and the initial value of c to be used would be the given value of c divided by n, while the deflection and the righting force would be the values read from the curves multiplied by n. That is, the scale of the curve is changed by properly introducing the factor n.

As far as the writer is aware, but little is known regarding the value of the initial stress which is desirable. As it is increased, the righting force for a given allowable stress in the wire is decreased, and as it is increased the rigidity of the stack is increased. The value chosen should be such as to give the necessary rigidity and at the same time give as high an efficiency as possible. Some idea of the location of this happy medium may be obtained from a study of Plate 3 and 4. It is seen in both cases that as the initial value of c increases a high degree of rigidity is first obtained when c is about 1,000 ft. With c much below this value, a considerable deflection is required to obtain any considerable righting force, as is seen from the curve for which c = 500 ft. while with c = 1,000 ft. the ratio of the righting

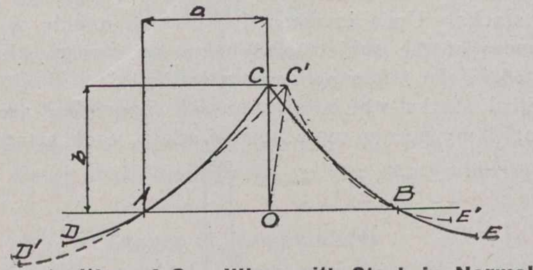

Fig. 2—Position of Guy Wires with Stack in Normal, and in Deflected Positions.

force to the stress in the wire is quite large. In view of this fact the writer suggests that c = 1,000 ft. be taken as the proper value to use when the ratio of a to b varies from 1 to 2 and a = 100 ft. This value of c corresponds to an initial stress of approximately 4,000 lbs. per sq. in. when a = b, and 3,900 lbs. per sq. in. when a = 2b, for a steel wire. When a = n × 100 ft., the proper initial value of c to be used to correspond to the above would be n × 1,000 ft.

Considering the numerical solution of a problem in which a = 100 ft. b = 100 ft. and the allowable stress in the wire is 16,000 lbs. per sq. in., in which it is desired to find the proper size of wire to be used if the stack is acted upon by an overturning moment equivalent to a horizontal force of 6,000 lbs. applied at the point where the wire is fastened to the stack. Reading from the curve for c = 1,000 ft. on Plate 4, the deflection is seen to be 0.110 ft. and the righting force is 9,400 lbs. per sq. in. The area of the section of the wire would be 6,000 divided by 9,400 or 0.638 sq. in. If the same problem had been solved by considering the wire on the taut side only, neglecting the loose wire, and considering it as acting at an angle of 45°, the righting force would have been 16,000 divided by the square root of 2, or 11,300 lbs. per sq. in. That is to say, with an initial value c = 1,000 ft. the slack wire causes a loss of possible righting force of only 1,900 lbs. per sq. in., or 17 per cent. and allows a deflection of only 0.110 ft. at a point 100 ft. above the base of the stack.

Consider the solution of the above problem with the wire fastened to the stack at the same point as before, but take the ratio of a to b equal to 2. That is, a = 200 ft. and b = 100 ft. The initial value of c = n × 1,000 ft., in which n = 2. The value of c to be read from the curve is 1,000 times 2 divided by 2, or 1,000 ft., and the allowable stress to be read from the curve is 16,000 divided by 2, equals 8,000 lbs. per sq. in. Reading from the curve for c = 1,000 ft. on Plate 3, the deflection is 2 times 0.052 = 0.104 ft., and the righting force is 4,800 times 2, or 9,600 lbs. per sq. in. The area of the section of the wire is 6,000 divided by 9,200, or 0.625 sq. in. If the taut wire only had been considered and that considered as acting in a straight line having a slope of 1 to 2, the righting force would have been 16,000 divided by the square root of 1.25, or 13,560 lbs. per sq. in. That is to say, with an initial value of c = 2,000 ft. the slack wire causes a loss of possible righting force of 3,960 lbs. per sq. in., or 29 per cent., and allows a deflection of 0.104 ft. Since the section of the wire is about the same, and the length of the wire is considerably greater in the second case than in the first, and as there is but little difference in the deflection in the two cases, it would seem that an arrangement of the wires so as to give a slope of 1 to 1 is better than with a slope of 1 to 2.

In the first numerical case considered above, it was noted that the slack wire had but little effect upon the value of the righting force for a given stress in the wire, causing a reduction of only 17 per cent. from the maximum theoretical possible. If however, the initial stress had been greater the reduction in the righting force would have been considerably more. For example, take the conditions of the problem the same as before except that the initial value of c be taken at 2,000 f. Reading from the curve on Plate 4 for a stress in the wire of 16,000 lbs. per sq. in., the deflection is 0.051 ft. and the righting force is 7,600 lbs. per sq. in., or a reduction of 3,700 lbs. per sq. in., or 32.7 per cent. below the maximum possible. If c had been taken equal to 3,000 ft., the deflection would have been 0.012 ft., and the righting force 2,400 lbs. per sq. in., a reduction of 8,900 lbs. per sq. in., or 79 per cent. These figures bring out quite emphatically the necessity of keeping the initial stress as low as possible without endangering the rigidity of the stack.

Ordinarily, when guy wires are erected, equipment is not available for measuring the stress in the wire and the use of such equipment would hardly be practical. However, a study of the curves shown on Plates 1 and 2 (Fig. 3) will suggest a means of determining the point at which the proper stress has been induced in the wire. By referring to these plates it is seen that each curve is made up of two almost straight lines connected by a sharp curve. When the stress has been increased to the point of sharp curvature, any further deflection of the stack is due almost entirely to the elongation of the wire. That is, after this point has been reached any further increase in the stress in the wire causes but little reduction in the sag in the wire. Also, after the stress is increased up to this point, any further taking up of the wire will cause an abrupt increase in the stress in the wire which ought to be noticeable in the equipment by which the stress is induced. For ordinary cases the wire ought to be stressed up to this point but not beyond it for the best results.

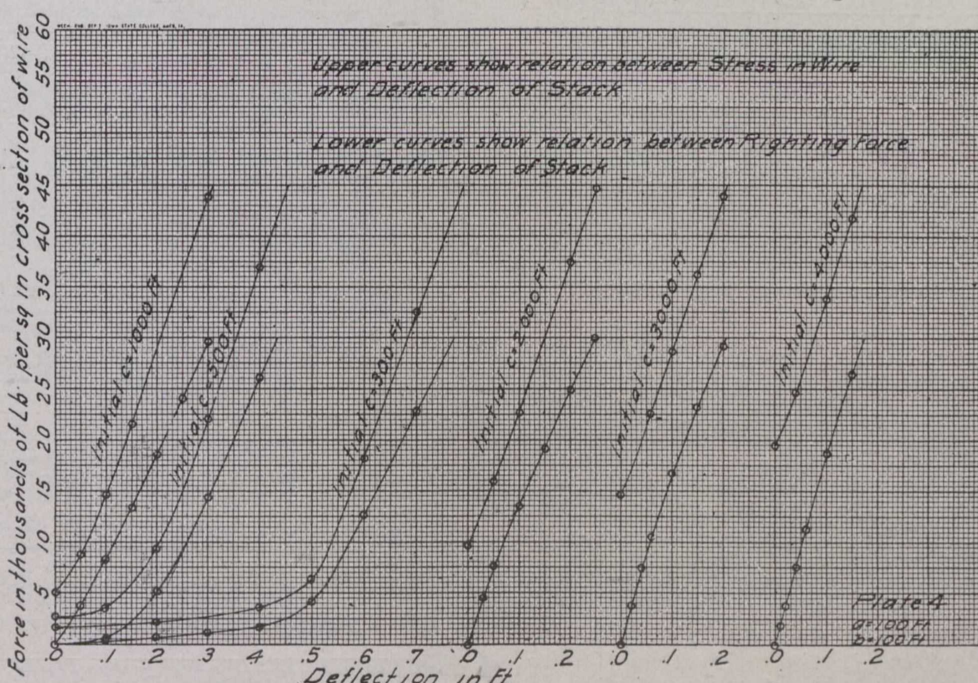

Fig 5—Stress in Wire, Righting Force and Deflection of Stack, when a = 100 Ft. and b = 100 Ft.

TO REMOVE RUST.

It is often very difficult and sometimes impossible to remove rust from articles made of iron. Those which are most thickly coated are most easily cleaned by being immersed in a solution, nearly saturated, of chloride of tin. The length of time they remain in this bath is determined by the thickness of the coating of rust. Generally, 12 to 24 hours is long enough. The solution ought not to contain a great excess of acid if the iron itself be not attacked. On taking them from the bath the articles are rinsed, first in water, then in ammonia, and quickly dried. The iron when thus treated, has the appearance of dull silver. A simple polishing gives it its normal appearance.

TOWN ELECTRIC POWER PLANTS

Town.	Power used to revolve Genreators.	No. of Consumers.	System of Charging.	Estimated Length of Line.	Generators. Maximum of current to be drawn.	No. of Trans-formers.	Pressure on Primary.	Cost of Complete Installation.	Systems in use.
Digby, N.S.	Steam	900-16 c.p. lights	Flat	2 Miles	1,000 K.W.	18	2,200 Volts.	$12,000.00	Alternating
Glace Bay, N.S.	Steam	700	10c. per K.W. hour, 25c.-50c., flat	20 "	140 Amperes	76	2,200 "	$85,000.00	Alternating
Pictou, N.S.	Steam	300	Meters, 16c. per K.W.	5 "		25	2,300 "	$47,000.00	Alternating
Newcastle, N.B.	Steam	250	Meters	10 "	150-225 K.W.	40	2,200 "	$30,000.00	Alternating
Bowmanville, Ont.	Steam & Water	220	Meters, 10c. K.W.H., flat rate	10 "	75 Amperes	30	1,200 "	$16,000.00	Alternating
Dresden, Ont.	Steam		Meters, flat rate.	3 "	62 Amperes	30	1,040 "	$12,000.00	Alternating
Chatham, Ont.	Steam & Gas	1,000	Meters, .06-.08c. per K.W. hour	24 "	675 K.W.	550	2,300 "	$150,000.00	Alternating
Brockville, Ont.	Steam	597	Meters	14 "	712 K.W.	63	2,200 "	$60,000.00	Alternating
Brantford, Ont.	Gas		Meters	5 "	125 K.W.	12	2,200 "	$50,000.00	Alternating
New Westminster, B.C.	Water	3,000	Meters	150 "	3,000 K.W.	1,500	1,150 "	$250,000.00	Alternating
Kelowna, B. C.	Steam		Meters, 15c. per K.W.	12 "	150 K.W.		2,200 "		Alternating

WATER WORKS

Municipality	Population	No. Con-sumers	Gallons Pumped An.		Gallons Per Day Per Capita	Pounds Pressure at Station		Cost of Pumping 3 months				Meters		
			Domestic	Manufacturing		Ordinary	Fire	Fuel	Oil and Waste	Labor	Total	Cost per 1,000 gallons	% Used	Rate per 1,000 gallons
								$	$	$	$	c.		c.
New Glasgow, N.S.	8,000	1,250	230,000,000	220,000,000	75	103	110	984.88	41.87	435.48	1,462.23	.012	4.8%	.03-.30
Stellarton, N.S.	4,000	500	119,289,600			100	100	219.00	25.00	200.00	441.00	.0148		.06
Pictou, N.S.	3,235	650	45,000,000		40	45-110		220.00	7.50	165.00	392.50	.0348		Flat rate
Westville, N.S.	3,925	850	30,000,000	32,000,000	25	185		180.00	650.00	239.50	1,069.50	.0688		.50
Digby, N.S.	1,500	250				95	125							
Lunenburg, N.S.	2,916	460				40	95				50.00			Flat rate
Newcastle, N.B.	3,000	250	35,000,000		100	80	125	500.00	230.00	270.00	1,000.00	.112		
Sackville, N.B.	5,000	400				60	80							Flat rate
Deseronto, Ont.	3,500	228				70	100	250.00		450.00	700.00			
Brantford, Ont.	23,000	5,278	961,188,483			80	120	1,380.14	78.15	*1,080.00	2,538.29	.0100	4%	.05-.10½
Berlin, Ont.	14,600	2,679	111,719,500	208,341,000	60	70	100	1,355.02	103.95	660.62	2,119.59	.064	75%	.06-.18
Aylmer, Ont.	2,167	450				40	90						100%	.06-.30
Brockville, Ont.	9,425	2,165	1,004,176,323					1,095.96	95.04	1,220.04	2,311.04	.0092		
Chatham, Ont.	5,500	400	84,250,000	80,000,000	81.8	71	71	1,385.70	33.12	1,150.00	2,568.82	.0628	8%	.07-.50
St. Boniface, Man.	8,085	864	55,000,000		40	70	100	640.00		937 00	1,577.00	.112	100%	.50
New Westminster, B.C.	15,000	3,000			78	80-150	100-180							
Kelowna, B.C.	2,250	173				60	120						55%	.20

* Including Engineer's Salary

The Canadian Engineer

ESTABLISHED 1893.

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Leading Articles:

THE NEW EDITOR.

With this issue the new editor takes up the reins of office. It will be our aim, in so far as is possible, to preserve the present high standing of the paper, and to expand and develop its field of operation as conditions will allow. There will be much to criticize, no doubt, but we ask your indulgence for the first few issues at least. During the past three and a half years of Mr James' editorship the paper has progressed steadily, and the present editor can only hope that the same measure of progress and success may be the lot of the paper in the changed hands.

In a rapidly growing country such as ours it is clearly impossible to note all the development and changes going on. But we shall endeavor to record whatever is best in our judgment, and whatever we feel will be an inspiration and an aid to the engineering profession.

There is no need to add that the same independent policy as heretofore will govern the columns of The Engineer. Whatever appears in its columns may be safely accepted as a fair, unprejudiced opinion from our standpoint.

THE TORONTO BUILDING BY-LAW.

The question of revision of the Toronto building by-law is up again. It will be remembered that late last May a Citizens' Committee, composed of representatives of several technical and business organizations of the city presented a memorial to the Mayor, the Board of Control and the City Architect, criticizing the present building code, offering suggestions where improvements were thought necessary, and asking that steps be forthwith taken to secure to Toronto a safe, workable and up-to-date building by-law.

On the advice of Mayor Geary the matter was presented to the Fire and Light Committee direct as being that branch of the civic administration which would ultimately handle the problem. The case was presented by representatives of the Engineers' Club, the Canadian Society of Civil Engineers, the Architectural Societies, the Canadian Manufacturers' Association and the Board of Trade. After much discussion the matter was referred to the City Architect for a report, which report he was instructed to have ready by August 1st. Following this, the City Architect and Chairman Hilton of the Fire and Light Committee made an extended trip to some of the cities of the central and eastern states with a view to finding what other places were doing, or had done, in the matter of improving city building codes.

At a recent meeting of the Fire and Light Committee it was evidently represented that an extension of time for the submitting of Mr. McCallum's report was necessary, for the committee granted time until January, 1912, in which to prepare it. Naturally, this delay caused some anxiety in the minds of the Citizens' Committee, and at a recent meeting they decided to take the matter up again with the Fire and Light Committee. This was done on Tuesday, and that body was urgently requested to take steps to hurry up the revision.

Now there are four points which are outstanding in the situation. The first is the necessity of improvement in the present by-law; the second is that the work of the Citizens' Committee cannot be ignored; the third is that the City Architect is exceedingly busy with the routine of his office in a year unprecedented in building operations, and the fourth is that the work of revision must **be done at once.** Plans for structures are pending to-day because of the uncertainty that at present hovers over the requirements of the City Architect's office. In the consideration of these items it would seem as though a Commission of Revision which can get to work at once and which can give its entire time to the work is the logical solution.

In case of Montreal a Citizens' Committee asked for certain changes. The city appointed a committee consisting of a lawyer, an expert and the city architect. Their findings will be ultimately considered by the Citizens' Committee.

A commission of experts should be appointed, with the City Architect in a consulting capacity. Let the experts be the best available, and let their qualifications rather than their place of residence or their affiliations be the sole reason for their appointment. Have them get to work at once, for the matter is an urgent one, indeed.

RESEARCH SCHOLARSHIPS.

It is with pleasure we note that sufficient funds have been placed in the hands of the Engineering Alumni of the University of Toronto to provide for two scholarships to be used in the interests of research in the faculty of Applied Science and Engineering. These will be the first offered in that faculty, and the results from their use will be awaited with interest.

Now that the Alumni have made a start along this line it should be easy to interest the Government in founding other research scholarships along applied science lines, for it is a department which the Government have not supported as they should. When we see the results obtained each year in the different states of the nation to the south from these scholarships and the allied Engineering Experiment Stations it is rather surprising that the Applied Science faculties in our Canadian universities have not had more cordial treatment.

If also the larger manufacturing companies could be brought to an understanding of their interest in the practical results to be obtained by money and influence invested in this, the results would certainly be far-reaching to the country as a whole.

CONTROL OF STREET TRAFFIC.

The control of street traffic, with the steadily increasing population in large Canadian centres, is beginning to engage attention. The Department of Trade and Commerce have instructed the Canadian Trade Commissioners to report on this, as well as other phases of municipal matters. In the weekly budget of the Department for August 14th is published the first series of these reports from Leeds, Manchester and Glasgow.

In Bradford, a city of 288,000 population, the remarkably small number of accidents to people boarding street cars is worthy of note. During 1910 there were only one hundred and fifty-six accidents as against six hundred and twenty-nine in Leeds, a city of 446,000 population.

The reason for the better showing in Bradford is due to the fact that the Tramways Department there have narrow gangways placed on the sidewalks in the centre of the city near to the point of departure of the cars. Persons desiring to board a car must first get into line in this gangway and enter the car from the gangway in rotation.

The Department of Trade and Commerce are to be commended in initiating this new work, for many new problems are developing with the increase in population in our Canadian cities. No doubt much valuable information will be secured by the several Trade Commissioners and placed at the disposal of those interested through the medium of the Weekly Report.

CANADIAN NATIONAL EXHIBITION.

The Canadian National Exhibition promises as usual to be finer than ever this year. As usual, every inch of space has been taken for months in advance in the Manufacturers' Building, and Machinery Hall will also be filled to overflowing. The latest labor and power-saving machinery will there be seen in operation.

To the early visitor at the grounds, however, it appears as if the exhibitors might be given more aid by the Exhibition authorities. What Machinery Hall needs is a new building equipped with travelling crane for handling machinery quickly; also a solid, heavy floor of concrete throughout the building. As it is, much time, money and energy is wasted in placing the different exhibits, while often the exhibitors are forced to spend large sums to provide sound foundations in place of the wooden floor at present there.

EDITORIAL COMMENT.

In a recent conversation Mr. J. G. Sing calls Toronto harbor the best harbor on the Lakes, and to a great extent his statement is correct. The harbor is safeguarded by a low sandbar, and the whole area of the harbor lies outside the main shore line. This is an important element in its favor, as no delay is occasioned in making Toronto a port of call. In addition Mr. Sing says that the harbor should be made to accommodate vessels six hundred feet long and drawing twenty-eight feet of water. This is true, for as soon as the Welland Canal is finished such vessels, now to be found only on the upper lakes, will be able to reach Lake Ontario, and Toronto should be able to afford them harbor and docking privileges. The water level in the harbor is now the lowest it has ever been for the summer months in the history of the port. The great need of the western channel, now under construction, has become evident through the present marked lowness of the water level.

* * * *

A form of tender for pipe sewers, as used by the city of Hamilton, recently came to hand. In it we notice that a deposit in cash or marked cheque to the order of city treasurer for the sum of 25 per cent. of the amount of work tendered for must accompany each and every tender. As the usual deposit on tenders is from 2.5 to 10 per cent., it seems to us as if 25 per cent. was rather heavy.

* * * *

"Please stop sending The Canadian Engineer to my address as our public library receive it, and I can read it there." The above is a copy of a letter received at this office which will hardly need comment. It would be interesting to follow the career of the writer for the next few years. It will be meteoric, no doubt.

CHANGE OF EDITORS.

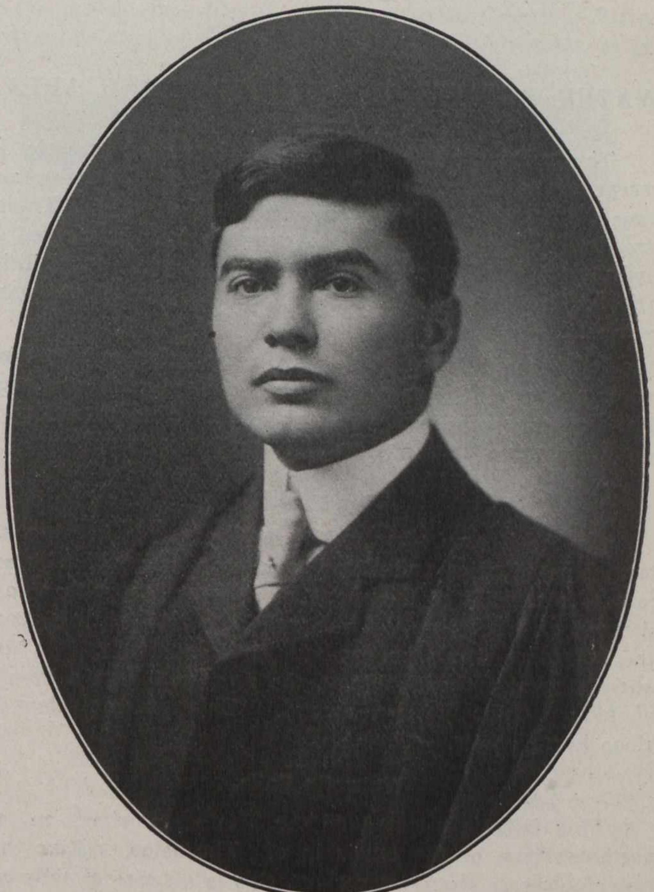
Mr. E. A. James, B.A.Sc., the Managing Editor of The Canadian Engineer, severs his connection with the paper with this issue. Mr. James has been associated with The Canadian Engineer in the capacity of editor for the past three years, and during that time has developed a very wide acquaintanceship with the en-

MR. E. A. JAMES, Retiring Editor.

gineering profession of Canada. His work has been uplifting, not only to the paper, but to the profession as a whole.

Mr. James, during the past year, has been doing considerable engineering work, and this work has developed to such an extent as to compel him to devote his whole time to it. He leaves to take up the duties of Engineer of North Toronto and Engineer for the Board of Highway Commissioners, York county.

Mr. T. H. Hogg, B.A.Sc., the new Managing Editor, has been employed during the past two years on the design and construction of the new works of the Ontario Power Company at Niagara Falls.



MR. T. H. HOGG, New Editor.

He is an honor graduate of the University of Toronto in Civil Engineering of the class of 1907.

THE BACK RIVER, MONTREAL.

The field staff of the Provincial Board of Health has completed the work of examining the Back River, and as a result of the work of the analysts, under Mr. M. H. McCready, it has been shown that the water of the river is unfit for human consumption in an unfiltered state.

The Montreal municipal council have had this source examined. Samples were obtained at various points on the river, and in all cases it has been found that the water is more or less polluted, the greatest degree of impurity being found between Cartierville and Bordeaux, where all the samples taken show the presence of bacteria in various quantities, ranging from 200 to 2,200 per C.C.

The heavy pollution met with is accounted for by the fact that several municipalities in the neighborhood have sewage outlets into the river. Montreal allows sewage from St. Denis ward to enter the river, whilst Bordeaux and other smaller municipalities also have outlets.

The statement of examination made of raw and filtered water in the Montreal municipal plant, the plant of the Montreal Water and Power Co., and the Beauharnois sterilization plant, show that the hypochlorite sterilizing process, continued to bring forth good results during the month of July. The analyses made by the provincial analysts, however, showed that the water supplied the citizens by the municipal plant was far superior, from a point of view of the absence of bacteria.

The comparative statements showing the number of bacteria in raw and sterilized water are as follows:

Montreal Municipal Plant.

	Raw water.	Sterilized.
July 6	1,850	5
July 12	293	11
July 20	150	6
August 3	136	8
August 9	110	14

Montreal Water and Power Company.

	Raw water.	Sterilized.
July 6	2,400	900
July 12	1,360	155
July 20	160	87
July 25	63	124
August 3	250	104
August 9	660	130

Beauharnois Sterilizing Plant.

	Raw water.	Sterilized.
July 5	10	4
July 11	91	7
July 19	368	8
July 25	104	7

WATER POWERS IN THE PORCUPINE AREA.*

The value of water powers has increased greatly in recent years owing to the introduction of electricity and long distance transmission of electrical energy. To-day practically all water power developments may be classed as hydro-electric. Hence it is easy to see the great possibilities afforded by Ontario's hinterland, which abounds in water powers.

It is the intention in this article to refer only to those water powers within easy radius of the Porcupine gold area. The importance of such water powers in close proximity to a mining camp does not call for further comment.

Grassy Falls.

On the Grassy river at the boundary line between the townships of Price and Fripp there is a series of falls and rapids, somewhat in the shape of a horseshoe, with a total descent of 106 feet. A flume and pipe line cutting across the horseshoe would be one-half mile in length. At low water stages, without storage, the river will have a flow of about 100 cubic feet per second. This is equivalent to 1,000 horse power.

Waiwatin Falls.

This falls is situated on the Mattagami river in the northeast part of the township of Thorneloe. Like the water power on the Grassy river, this is a series of falls and rapids and of similar shape. For development purposes a

Part of Waiwatin Falls on Mattagami River.

flume and pipe line about 70 chains long will be required. The total fall under natural head is 116 feet, and the flow 400 cubic feet per second, at low stages, giving about 4,000 horse power. The drainage area at this point on the river is approximately 1,200 square miles.

*From Annual Report of Bureau of Mines, Ontario, for 1911.

Surveys and plans for this development have been completed, although no machinery is on the ground. The transmission line has been located on sand plains and jack pine ridges for almost the entire distance, with the object of constructing either a wagon road or electric railway. The dam required can be easily constructed. E. A. Wallberg has leased this water power and under the conditions must develop 4,000 horse power of electrical energy by September, 1912. The transmission line to the Hollinger mine is eleven and one-half miles in length.

Sandy Falls.

Sandy Falls is located on the Mattagami river in concessions IV. and V., Mountjoy. This water power consists of a series of three falls with intervening rapids and swift water. The upper part has been leased to the Porcupine Power Company, while the lower part is under lease to other parties. Under natural conditions the total descent is 44 feet.

Active development work by the Porcupine Power Company has been carried on during the past winter, and the company expects to supply electrical energy by early summer. Two electrical units of 1,500 horse power each are being installed. The transmission line from the power house to the Hollinger mine is six miles in length. The right-of-way, 132 feet in width, has been cleared of timber and a pole line erected.

At Sandy Falls the natural head has been increased by a dam which will eliminate all current from the river as far upstream as Timmins Landing, or the mouth of Mountjoy creek. This will allow the power plant to operate under an effective head of 34 feet. Although the available head here is much less than at Waiwatin the volume of water is greater. The drainage area of the Mattagami river at Sandy falls has been increased to about 2,500 square miles by the additional territory supplying tributary feeders, namely, Mountjoy creek and the Grassy and Redsucker rivers. Thus without storage, a flow variously estimated from 800 to 1,400 cubic feet per second will be obtained at low water stages. Lakes near the head waters of the Mattagami can be dammed, thereby retaining flood waters to increase the flow at low stage periods. Experience has shown that many of the rivers of northern Ontario have an average flood discharge of about twenty times the low water flow.

MANUFACTURING CONCRETE PILES.

The following costs of manufacturing concrete piles are taken from the Canal Record for August 9th, 1911.

Items.	Atlantic Division			
	April.	May.	June.	Total.
Quantities—lineal feet.	10,002	5,904	5,760	21,666
Cement	$0.1024	$0.0828	$0.0760	$0.0900
Stone	.0750	.1176	.1145	.0971
Sand	.0178	.0255	.0080	.0173
Mixing	.0358	.1157	.0512	.0617
Placing	.0334	.0711	.0323	.0434
Reinforcements	.8584	.7276	.6346	.7734
Forms	.0922	.0344	.0786	.0729
Maintenance of equipment	.0053	.0054	.0114	.0069
Plant arbitrary	.1794	.1700	.1700	.1743
Division expense	.0114	.0170	.0210	.0155
Total cost	$1.4111	$1.3671	$1.1976	$1.3525

TESTING CLINKER CONCRETE.*

John Charles Davis,
Dean of College of Applied Science and Engineering, Marquette University, Milwaukee, Wis.

For the last two months the writer, with the assistance of Messrs. Collins, Kurtz, Miller and Steigerwald, of the Junior Class, has been making some very interesting tests on concrete and reinforced concrete. The work has not been carried far enough to give scientific results but the practical points have been fully demonstrated.

The material for these tests was Huron Portland cement furnished by the Western Lime and Cement Co.; clinker from the Milwaukee Incinerator, furnished by Mr. S. E. Greeley and gravel from the J. C. James gravel pits. The cement has been tested in the regular laboratory and met all standard specifications. The gravel was fine and clean and for test purposes it was screened through a ⅛-inch screen; that passing through being called sand and the remainder called gravel. The clinker is the product from the furnaces at the new garage incinerator and results from the burnings of a

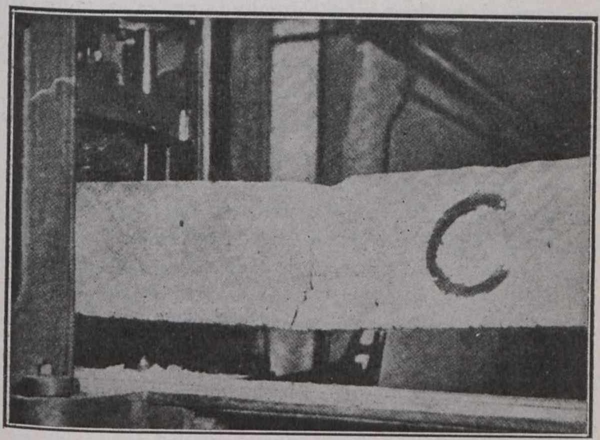


Fig. 1.

mixture of garbage, refuse and ashes. It is a surprisingly hard and strong product and very rough. It looks exactly like the clinker from any furnace but it is not mixed with ashes. This is due to the particular method employed in burning. Ordinarily cinder concrete is supposed to average about one-third the strength of gravel concrete, but this clinker concrete was better than the gravel concrete made in our laboratory.

When the tests were started it was the intention to investigate the strength of reinforced clinker concrete as compared with reinforced gravel concrete. Four clinker concrete beams, with a mixture of one part cement, two parts sand and four parts clinker, were made and tested in the 50,000-pound testing machine in the engineering laboratory. Three of these were reinforced with a ½-inch Kahn bar and one with four ⅜-inch plain round bars. Each one was 9½ inches high by 6 inches wide and the steel placed 1½ inches from the bottom. Two gravel concrete beams of a 1-2-4 mixture were made so as to compare the clinker beams with a standard material. Each of these was reinforced with one ½-inch Kahn bar and were 9½ inches deep. One was 6 inches and the other 7 inches in width. All the beams reinforced with a Kahn bar failed by compression of the concrete under a central load of about 4,000 pounds, the span in all cases being 10 feet. It was very noticeable during the application of the load that the deflection of the beam varied directly with the load up to the point of failure. Even after the beam showed failure the load remained equal to the breaking load for a deflection of about 2 inches. Figures 1 and 2 show a close picture of the ordinary crushing failure. The material in the top of the beam appeared to crumble away under the heavy compressive stress. Figure 3 shows a detail of the beam reinforced with plain round rods. This is the typical shearing of diagonal tension failure. During the application of the load the beam acted similar to the

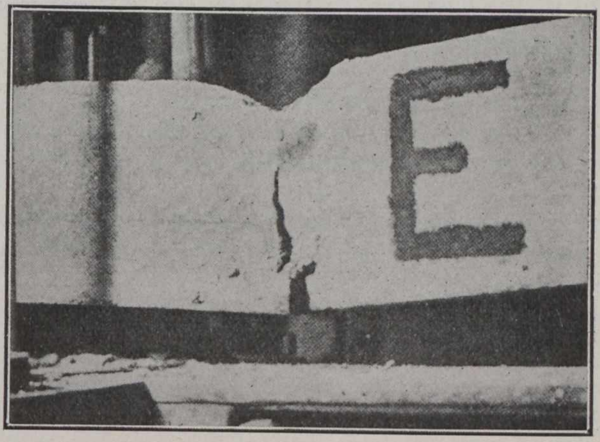


Fig. 2.

others up to a larger load of 5,000 pounds, when the large crack appeared suddenly.

The table shows a summary of the beam tests:

Material.	Maximum load.
No. 1 gravel	4370
No. 2 clinker	3500
No. 3 clinker	3480
No. 4 clinker	4200
No. 5 clinker	5100
No. 6 gravel	4000

To determine the actual strength of the concrete used in the beams sets of 4-in. cubes were made and tested at 7 and

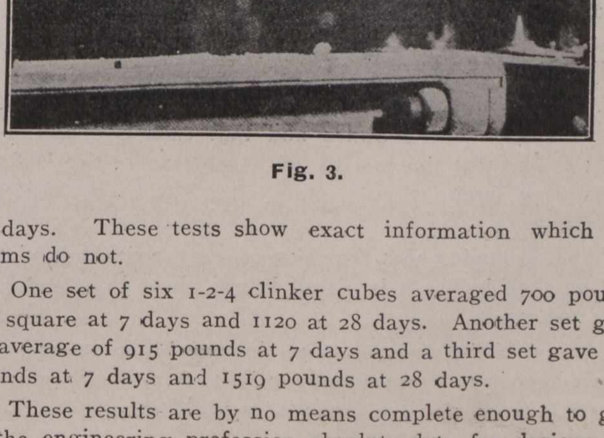


Fig. 3.

28 days. These tests show exact information which the beams do not.

One set of six 1-2-4 clinker cubes averaged 700 pounds per square at 7 days and 1120 at 28 days. Another set gave an average of 915 pounds at 7 days and a third set gave 760 pounds at 7 days and 1519 pounds at 28 days.

These results are by no means complete enough to give to the engineering profession absolute data for design, but they are complete enough to make the following assertions:

*Marquette University Monthly.

(1), the clinker concrete is better than the ordinary gravel concrete; (2), it is almost if not quite as good as the best gravel concrete; (3), it is far superior to cinder concrete; (4), if properly mixed it will give uniform results under test; (5), it can be used to advantage in mass concrete; (6), the tests have not been carried far enough to warrant its use in reinforced concrete; (7), that the city of Milwaukee can use this material for any of its concrete work and provide an income for the running of the garbage disposal plant. Further tests are necessary to determine the mixture of cement, sand and clinker which will give the maximum strength for the same cost of materials.

CROSS-TIES.

The Forestry Branch of the Department of the Interior has collected statistics with regard to the cross tie consumption in Canada for 1910.

There were 9,213,962 cross ties purchased in 1910 by the steam and electric roads of Canada at a cost of $3,535,228. This is a decrease of 35 per cent. from the number purchased in 1909. The average cost of these ties at the point of purchase was 38 cents per tie. Three kinds of wood, cedar, jack pine and hemlock furnished 77 per cent. of all the ties purchased. Cedar itself supplied 40 per cent. of the total consumption and its use is increasing yearly in proportion to other species. Oak, which makes an expensive tie, costing 74 cents each, was used principally by an United States company having mileage in Canada. Of the total number of ties purchased, 70 per cent. were hewn ties. The only important species which has a majority of sawn ties, was oak. Sawn ties cost on the average 36 cents per tie and hewn ties cost three cents more. The steam railways used 95 per cent. of all the ties and these ties cost them on an average of 38 cents. The electric railways used 302,540 ties—an increase of 183 per cent. over 1909. They paid for their ties 41 cents each. Although on the average they use smaller ties, this excess of 3 cents in the cost is due not only to the disadvantages incident to contracts for smaller quantities of material but also to the fact that the electric roads are more likely to purchase ties at points where the price includes transportation charges.

WASTE IN SPARE AUTOMOBILE TIRES.

Spare tires, which are not included in the equipment of Franklin cars, the manufacturers claiming they are unnecessary to their form of construction, are the basis for a few interesting figures submitted by an engineer of that company as follows:

"Assuming that there are in round numbers 500,000 automobiles in the United States and that each one carries a spare tire and that the cost of the average spare tire is $47, the motoring public of this country has $23,500,000 tied up in this form.

"And, assuming that the value of a spare tire depreciates about one-half before it is placed in use, there is a dead loss of $11,750,000.

"Again, if the average spare tire weighs 25 pounds, the cars are carrying an unnecessary weight of 12,500,000 pounds.

"Further, if the average owner drive 500 hours a year at 20 miles an hour there is a total yearly waste of 4,337,000 horse power in carrying the spare tires."

SIXTY-TON TEST ON CONCRETE PILE.

The following test on a concrete pile was made during the course of last year by Lockwood, Greene & Co., of Boston, on a Simplex concrete pile driven at the New Print Works of the Pacific Mills by the New England Foundation Co., the contractors. Although the duration of the test was two months, and the local 60 tons for more than one month, the settlement recorded was practically negligible. It should be noted that the pile was driven in the spring of the year when the ground was moist and cold, causing the concrete to set comparatively slowly.

The figures have added value, as data on this subject is extremely scarce, principally due to the fact that there is not usually an opportunity for testing a pile which will see actual service. However, conditions at the Pacific Mills are such that a complete test was possible. Since the methods employed in the tests were carefully arranged and all readings made and checked by two engineers of an unprejudiced firm, the data is absolutely reliable. The conditions of the tests were worse than would be set in general practice and it should be remarked here that the pile selected for the test was one that did not look as fit as the others.

The general method used in the simplex system consists in driving to a suitable bearing, under a drop hammer, operated in a substantially rigged pile driver frame, a 16 in. diameter, ¾ in. thick hollow cylindrical steel tube or form to the lower end of which is fitted loosely with a conical cast iron point. As practically the entire energy of the hammer is delivered to the point full value is given to the penetration, equal compression to the soil all the way down, and developing the full bearing value of the soil, from top to point. Upon reaching the required depth the form is filled with soft concrete, by means of drop bottom buckets, to a sufficient height and quantity to fill the pile hole to proper level. The form is then pulled out, leaving the point in the ground, the concrete being forced down and out by its own weight, thereby completely filling the hole to its compacted wall. The concrete is always placed before the removal of the form, no shell being left in the ground.

The pile under test was driven on the banks of the Merrimac River through a stratum of gravel which is filled with water. In order to keep the water out of the tube while it was being filled with concrete, a coil of oiled jute was placed between the cast iron point of the pile and the steel tube.

To obtain an even bearing area for the load, the pile was cut off, capped and then surmounted by an iron plate upon which were balanced 8 in. x 16 in. timbers over which were placed similar timbers at right angles. The platform was then erected to support the brick wall.

By counting three different piles of one hundred bricks each the average weight per brick was found to be 5.18 lbs. Every part of the platform and all materials supporting the brick load were carefully weighed previously and found to weigh 3456 lbs.

Readings were obtained by means of a piece of 1¼ in. gas pipe 17 ft. long placed upon the iron plate between the timbers and by referring to a nail head placed in the river wall nearer the pile and assumed as zero. Readings were taken daily at nearly the same hour, corrections of temperature for above gas pipe being made after June 2nd. Observations were recorded by one engineer of Lockwood, Greene & Company and checked by another of the same firm, both readings being kept.

The test begun on May 13th which was ten days after the pile was driven. A load of 30 tons was applied on the 14th and this was not changed until May 19th, the difference of readings being .006. On the later date 15 more tons were applied, making the load 45 tons. On the 8th of June the load was finally increased to 60 tons, and this was left until July 14th. The total variation for May 14th to July 14th, when the test was closed, was .012 which was the apparent settlement. Below is the data on driving and the readings taken from June 8th to July 14th with a load of 60 tons.

Data on Driving.

Diameter of pile	16 in.
Length of pile	19 ft. 7 in.
Hammer weight	3300
Drop of hammer	8 ft.
Penetration in last 8 blows	1¾ in.
Number of blows	300.
Concrete mixture	1 : 2½ : 5
Date of driving	May 3rd, 1910.
Test started	May 13th, 1910.

Elevation Taken on Concrete Pile Test at Pacific Mill's New Plant, So. Lawrence—Load 60 Tons.

Date. 1910.	Elevation.		Date. 1910	Elevation	
June 8	3.619	(windy)	June 27	3.6112	
9	3.619		28	3.6197	
12	3.6189		29	3.6186	
13	3.6175		30	3.6135	(windy)
14	3.6163		July 1	3.6175	
15	3.6167		2	3.6180	
16	3.6152		5	3.6194	
17	3.615		6	3.6189	
18	3.6145		7	3.6165	pile
20	3.6154		8	3.6183	driver
21	3.6146		9	3.6206	working
22	3.6161		10	3.6207	nearby
23	3.6114		11	3.6205	(windy)
24	3.6188		12	3.6186	
25	3.6162		13	3.6214	
			14	3.6160	

RESULTS OF INVESTIGATION OF STRESSES IN LOCUST STREET BRIDGE AT DES MOINES, IOWA.*

By C. E. Goodin, C.E.

The Locust street bridge in Des Moines is a five-span reinforced concrete arch structure across the Des Moines river. It consists of a 72-foot, an 82-foot, a 92-foot, an 82-foot, and a 72-foot span in consecutive order.

On making a personal inspection of the bridge as it now stands it was found that there was a fine transverse crack on the under side of the arch ring near the crown in each of the 72-foot spans. We were unable to inspect the 82-foot and 92-foot spans.

To account for the cracks it was decided to investigate the stresses in the bridge.

In figuring the stresses the dead weight of the earth filling was assumed to be 100 pounds per cubic foot and of concrete 150 pounds per cubic foot. A live load of 150 pounds per square foot was used.

Temperature stresses were figured for a range of 40 degrees each way from the mean. A range of 40 degrees was taken because the results of actual measurements of the temperatures in a concrete arch, made in the vicinity of the college, indicated that the range was at least that much, and a little more in some cases.

* The Iowa Engineer.

Rib shortening stresses were also calculated. The maximum stresses were as follows:

72-FOOT SPANS

Point	Compression in Concrete	Tension in Steel
B3-R-1	1300 lbs. per sq. in.	54000 lbs. per sq. in.
B1-R-3	1150 lbs. per sq. in.	49000 lbs. per sq. in.
B1-R-6	500 lbs. per sq. in.	10000 lbs. per sq. in.
B1-R-Spr	315 lbs. per sq. in.	15500 lbs. per sq. in.

82-FOOT SPANS

Point	Compression in Concrete	Tension in Steel
B3-R-1	1250 lbs. per sq. in.	44000 lbs. per sq. in
B1-R-3	1100 lbs. per sq. in.	39500 lbs. per sq. in.
B1-R-6	550 lbs. per sq. in.	7500 lbs. per sq. in.
B1-R-Spr	335 lbs. per sq. in.	15000 lbs. per sq. in.

92-FOOT SPANS

Point	Compression in Concrete	Tension in Steel
B3-R-1	1390 lbs. per sq. in.	56000 lbs. per sq. in.
B1-R-3	1250 lbs. per sq. in.	49000 lbs. per sq. in.
B1-R-6	550 lbs. per sq. in.	9000 lbs. per sq. in.
B1-R-Spr	490 lbs. per sq. in.	32000 lbs. per sq. in.

B1 equals load on right half.
B2 equals full live load.
B3 equals live load ¼-¼ point.

R equals right. 1-3-6, etc., are points of application of loads, numbering from zero at the crown of the arch to No. 8, left and right. Spr. equals springing.

From the table of stresses it will be seen that, under the assumed loadings and temperature stresses, in the 72-foot spans the steel is stressed up to 54000 pounds per square inch, and the concrete up to 1300 pounds per square inch.

As the working stress in steel is usually taken as 16000 pounds per square inch and in concrete from 600 to 800 pounds per square in, according to the "elastic theory," the structure is much too light for the loading and temperature variation assumed.

As the cracks were found at the same points as the computed high stresses, the correctness of the range of temperature used and that of the "elastic theory" followed in the computation are evidently confirmed.

While there is much talk against the "elastic theory," mainly on the part of contractors who wish to build light bridges, it is generally found that when bridges are designed according to the theory they prove safe and substantial, when a sufficient range of temperature is used in the computations.

WATER POWER ON THE DANUBE.

Two great projects for employing water power for the generation of electric power are now under consideration in Hungary and Croatia. One, due to Albert Bass & Company, of Basel, is to use the Danube in its flow from Pressburg to Raab, a distance of about 40 miles in West Hungary. A navigable canal is to be dug for navigation and irrigation and three reservoirs are to be made, at Pressburg, Wieselburg and Raab, respectively, to supply 40,000 h.p. for driving dynamos. The total cost will be nearly two millions sterling. The other proposal is to utilize water power at Zeng on the Adriatic coast of Croatia. Here from 60,000 to 80,000 h.p. can be got to supply Fiume and the rest of the Austrian coast with light and power, and especially for railway traction. The cost of this larger undertaking would approach £4,000,000.

COST OF WELL SINKING.*

No other information connected with well sinking is so hard to obtain or, when obtained, is of so little general value as that relating to cost. In regions where many wells of a particular class have been sunk figures of cost may be fairly reliable; but where underground conditions are not so well known such information is more indefinite and is often withheld by drillers or contractors for business reasons.

The cost of sinking wells is determined chiefly by economic conditions, including cost of labor, material and transportation; by the size and depth of the well; by the character of the material penetrated, and by the method of drilling employed.

If a well is sunk in a rather inaccessible locality, where fuel is scarce and labor is high, the cost will, of course, be much greater than that of a well sunk by the same method through similar formations in localities where labor and material are cheaper and transportation charges are less.

Increase in diameter of the hole not only increases the cost of sinking because of the additional material that must be removed, but it demands larger and more expensive tools and more power to operate them. The cost of each foot drilled increases rapidly with the depth, for more time is lost in changing the tools and cleaning the hole, and progress is slower because of the decreased speed at which the tools must be operated. Greater labor and ingenuity are also involved in recovering lost tools and overcoming other difficulties.

The rate at which sinking proceeds determines the time required to complete a well, and hence it is an important factor in the total cost. The rate of drilling depends both on the material penetrated and the method of sinking employed. Drilling advances much slower in hard, tough rock than in more friable material, and even in plastic clays it is slow, as the material is difficult to penetrate. Quicksands also may cause trouble in some wells. With auger or jetting outfits, however, quicksands can be much more easily and cheaply penetrated than with other outfits.

As the size of the parts and the number of accessory tools for the various rigs depend on the size of the hole to be sunk and the conditions to be met, the figures of cost here presented for the various outfits must be regarded only as approximating the price of the more usual outfits at or near supply points.

Standard method.—The regular standard outfit, including rig, power and tools, in the Pennsylvania oil fields costs from $1,700 to $3,000 or more. A 72-foot derrick with reels and iron-work costs $600 to $750. The boiler employed varies from 15 to 40 horsepower and the engine from 12 to 30 horsepower, the size depending on the depth to be drilled; the two cost between $600 and $900. The necessary tools usually cost about $500, though fishing tools and other extras may involve an aggregate expenditure for the outfit of as much as $4,000.

The average cost of oil-well casing ranges from 40 to 50 cents a foot for 4-inch to about $2 a foot for 12-inch, though the price varies with the iron market and with the freight charges.

In the Gains oil field of northern Pennsylvania, where drilling sometimes proceeds at the rate of 70 feet in twenty-four hours, through shales and shaly sandstones and limestones, drilling is done by contract at about 65 cents a foot, the cost of casing being additional.

*From Water Supply Paper No. 257 of the U.S. Geological Survey.

In the Coalinga oil district in California, where water has to be purchased and forms an extra item of expense, the average cost of a 4,000-foot well has been estimated at $7,500, divided as follows: Labor and water, $1,500; casing, $2,500; outfit, $3,500. Many of the deep wells in this district, which start with a casing 11⅝ inches in diameter, greatly exceed this average cost, however.

In the Summerland oil district of California wells 6 or 8 inches in diameter at the top and about 250 feet deep are put down at a cost of about 85 cents a foot for drilling only

Portable rigs.—Portable rigs are much used for drilling water wells 4 or 6 inches in diameter. A machine capable of drilling to a depth of 1,000 feet costs about $1,100 with nontraction power and about $1,400 with traction power. The tools for such a machine, exclusive of cables, cost $400 to $500 additional. Lighter machines, with a capacity of about 300 feet, cost about $700 with power, this amount being about equally divided between the machine and the engine and boiler. Tools and cable for such a machine cost $200 to $250 more.

The rate of drilling with portable outfits varies. In shale, soft sandstone and similar materials 30 to 50 feet a day is a common record; in hard sandstone, 15 to 25 feet a day, and in clay and other unconsolidated material, 75 to 100 feet a day is a fair average.

The cost of drilling wells varies from 10 to 15 cents a foot in the softer materials to $1 or more a foot in hard rock. In the northern Mississippi Valley 4-inch and 6-inch wells in shale and limestone cost 50 cents to $1 a foot for drilling only; in quartzite the cost runs up to $3 and $4 a foot.

In the hard, tough lava of eastern Washington, where in some wells only 2 or 3 feet a day can be drilled, the drillers charge $2.25 to $3 a foot, fuel and board being furnished them.

The portable rig has been used in drilling shallow holes of small diameter for blasting or exploration purposes at a cost as low as 8 cents a foot.

Pole-tool method.—The figures of cost given above also apply approximately to wells drilled with Canadian pole-tool outfits, for the chief advantage of the use of the pole-tool outfit in some parts of the country is its adaptability to drilling wet holes.

Self-cleaning or hollow-rod method.—Hollow-rod tools are often used with a portable machine built for cable tools, the rods and other extras costing $150 to $250 for a capacity of 250 feet. Additional rods cost 25 cents to $1 a foot, depending on their quality. The common sizes are 1 to 2½ inches in diameter.

Machines built especially for hollow-rod tools, complete with horsepower attachment, tools and 100 feet of rods, cost from $225 for 2-inch outfits to $325 for 5-inch outfits. The price for a machine with a 5 or 6 horsepower engine and boiler ranges from $650 to $800.

The cost of drilling with hollow-rod tools does not differ greatly from that with small portable cable rigs under similar conditions, but no specific figures are at hand. It is, however, usually 20 to 30 cents a foot, without casing.

California or stovepipe Method.—Concerning the California or stovepipe method of well sinking, the following figures have been published. The machinery and power cost $1,500 to $1,800 and the tools and accessories $500 or more additional, and a pair of hydraulic jacks cost $250. The following tables show approximately the cost of sinking wells by this method and the cost of stovepipe casing. The latter cost, of course, varies with the price of steel:—

Cost Per Foot of Drilling Wells by the California or Stove-pipe Method.

	4-in.	5-in.	6-in.	7-in.	3-in.	9½-in.	10-in.
First 100 feet	$0.30	$0.30	$0.35-0.40	$0.40	$0.40-0.50	$0.60-0.65	$0.65
Additional for each 50-foot increase in depth	.25	.25	.20-.30	.20-.35	.20-.35	.20-.35	.35

Cost of Riveted Steel Well Casing in 2-Foot Joints.

Diameter Inches.	Gauge.	Price per foot.	Diameter. Inches.	Gauge.	Price per foot	Diameter. Inches.	Gauge.	Price per foot
4	16	$0.32	7	16	$0.48	9½	14	$0.75
4	14	.38	7	14	.55	9½	12	.94
5	16	.35	8	16	.55	10	16	.68
5	14	.43	8	14	.64	10	14	.78
6	16	.42	8	12	.78	10	12	.98
6	14	.50	9½	16	.65			

At the prices given in the preceding tables a 6-inch well 500 feet deep, with casing, would cost between $750 and $1,000, assuming that the initial diameter is maintained all the way down.

The average rate of sinking wells by this method is 40 to 50 feet in a 10-hour day.

Hydraulic rotary method.—The hydraulic rotary method of drilling, like the standard method, requires heavy machinery, and the cost of the outfit is consequently high. In the Beaumont field of Texas the derrick costs about $125, and the machinery, including two boilers and two pumps, costs about $3,600. For wells approximately 3,000 feet deep a 30 to 40 horsepower boiler, 10¼ by 12-inch single-cylinder engine, and duplex pumps, with cylinders 10 by 5 by 12 inches, are commonly used.

Water wells 400 to 1,000 feet deep and 6 to 8 inches in diameter have been put down in southern Arkansas with hydraulic rotary outfits for $2.50 to $5 a foot, including casing.

In the Beaumont oil field of Texas the contract rate for sinking by this method has averaged $4 to $4.50 a foot, including casing. In this region it takes about two months to drill a well 800 to 1,000 feet deep.

Jetting method.—No figures are at hand as to the cost of jetting machines, but as the main parts of the outfit are a small derrick and a force pump the apparatus is not expensive.

In southern Arkansas 4-inch wells have been jetted down to a depth of 400 feet at a cost of $1 a foot without casing; in Louisiana smaller wells have been sunk at an average cost of 39 cents a foot. In the Coachella Valley, in southeastern California, 4-inch wells are sunk and cased by contract to depths of 500 and 600 feet for $1 a foot. In the coastal plain of southern California wells 2 to 4 inches in diameter and usually less than 100 feet deep are sunk by this method for 30 to 40 cents a foot, the cost of casing being additional.

Core drills.—Core drills are made in a number of sizes, from hand-power machines of 300-foot capacity to electric or steam driven machines capable of boring to depths of 6,000 feet.

A hand-power drill with accessories and 200 feet of rods, is listed at about $600, and a more powerful machine, with accessories and 2,000 feet of rods, is quoted at approximately $5,500.

In 1906 the market price of carbons was $85 to $90 a carat. Since 8 stones weighing 1 to 4 carats apiece are required for each bit the bits may cost as much as all the rest of the outfit.

The wear on carbons is usually 30 to 80 cents a foot, averaging 30 to 40 cents in moderately hard rock. The total cost of drilling in moderately hard material under ordinary conditions have been $1.50 to $2.50 a foot for holes 1¼ to 1¾ inches in diameter.

Records of rates of drilling show an average in chert and quartz of 75 to 80 feet for a week of 60 hours; in basalt, sandstone, slate, and diabase, about 100 feet; and in limestone 150 to 200 feet.

It is claimed that the cost of drilling with calyx and shot bits is less than that with a diamond bit under the same conditions, and that cores of larger diameter are obtained.

When chilled shot are used, the consumption is one-quarter to three-quarters of a pound for each foot drilled in soft rock, and 1½ to 4 pounds in hard material.

Augers.—Hand augers to be used with common water pipe as extension rods are on the market, and range in price from about $5 for 2-inch augers to $40 or $50 for 10 and 12-inch sizes. Horsepower machines capable of boring wells 100 feet deep and 40 inches in diameter are listed at about $200.

Water wells 3 or 4 inches in diameter can be bored with hand augers at a cost of 25 to 35 cents a foot without casing; wells 6 inches in diameter have been sunk at a cost of about 50 cents a foot. With the Arkansas clay auger, using horsepower, wells are put down at a cost of 12½ to 40 cents a foot.

Driven Wells.—The cost of driven wells consist mainly in the outlay for drive point and strainer, pipe, and suction pump. The driving itself does not require expensive machinery nor skilled labor.

A 1½-inch drive point and screen costs about $2.50; 25 feet of 1½-inch pipe, about $3; and a pitcher pump, about $5; so that the cost of small driven wells should not be more than $15.

ASBESTOS MINES.

The mines of Canada to-day produce the major portion of the asbestos used in the industrial world. For six decades or more it was known that Canada possessed this mineral, but the fact was not considered of commercial importance. In 1877 a farmer discovered deposits of considerable area and the first real mine began operations shortly afterward. It is said that the enterprise was a paying one from the start. Asbestos was first mined in Italy, and prior to 1880 it was the only country that produced it at a commercial profit. The Italian asbestos is very silky in appearance and gray or brown in color. Often the fibres are several feet in length.

The Panama Railroad Company has received 8,000 hardwood ties for use on its permanent line. These ties are purchased in Columbia and are shipped via the Royal Mail Steam Packet Company's vessels from the ports of Savanilla and Barranquilla. The majority of the ties are hewn from guaiacum, or lignum vitae, but three other classes of hardwood are accepted, namely, polvillo, corteza and balsamo. On account of the hardness of the wood, the ties have to be bored for the spike. A special tie-boring and gaining machine is used, which adzes two parallel faces to form the seat for the tie plate, and bores a hole to receive the spike. A patent tie plate and screw spike are used. This equipment holds the rails to absolute gauge, and guards against a tendency for the rails to spread. A good many of the soft wood ties on the permanent track between Panama and Corozal have been replaced with hardwood, and the same equipment has been extended to other sections of the permanent, or relocated line, where 90-pound rails are being laid.

METHODS AND COST OF STRIPPING WITH STEAM SHOVELS IN UTAH.*

The Utah Copper Company owns 580 acres of ground which was first exploited for the ore by underground methods, but when the extent of the deposits were satisfactorily proved the underground method was abandoned and the tract is being stripped by steam shovels. A section through the ore, shown by Fig. 1, illustrates the lay of the land and at once shows the adaptability of the bench method of working steam shovels.

The average thickness of the cap is 70 ft., representing about 115,000 cu. yds. per acre to be removed. Assuming that the cap weighs 2 tons per cu. yd., as has been ascertained in other similar deposits, the cost of stripping during the year 1909 was 35.2 cts. per cu. yd. or, allowing for all expense such as railway construction and dumping rights, 53.1 cts. per cu. yd. The great elevation of the upper portion of the deposit has made necessary the construction of narrow gauge tracks for handling the material, this being the item represented as railway construction.

The vertical distance from the lowest point in the canyon to the highest point of the work is 1,850 ft. This is divided into 22 benches on most of which the work is in progress. The lowest bench, which is above the portion called the pit, is 240 ft. high. The remaining benches are each 75 ft. high, except some at the top, which were started by another company, and which are 60 ft. high. The 240 ft. bench is all in ore, which is of a uniform grade so that it can be worked to a greater height than is customary.

*Abstract from an article by L. A. Palmer in the "Mining Magazine."

The shovels used on the work are 2 Marion (model 95), 2 American, 2 Marion (model 60 with 2½-yd. dippers), the remainder being Marion Model 91, with 3½-yd. dippers. There are 24 shovels on the work and allowing for those laid up for repairs there is an average of 20 in continual operation. The narrow guage cars used on the upper levels are 4 cu. yds. capacity, but the standard guage cars used below are the standard type of steel cars, with two way dump, and a capacity of 12 cu. yds.

Churn drills are used for both prospecting and mining. Four of these are Star machines and the rest Keystone, six being used for each class of work. The rock is comparatively soft and the shattered condition makes it difficult to get a good core and therefore core drills are not satisfactory. The bits used vary from 4 to 12 ins., 6-in. bits being used for the blast holes. The Star machines, which are the heavier of the two used, have 16 h.p. engines with 8x8-in. cylinders and are adjustable crank, usually run with an 18-in. stroke. The weight of the tool on Star drills is about 2,000 lbs. and on the Keystones about half as much. Two men are employed to a drill, an engineer and a driller, and one of the heavier machines will drill 15 to 25 ft. in a 10-hr. shift.

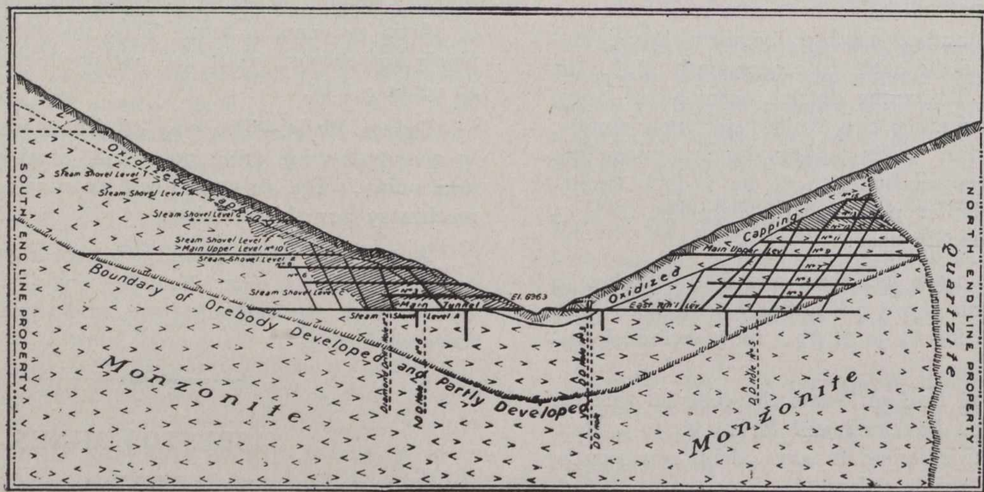


Fig. 1—Section Showing Ore Body, and Bench Method of Stripping.

For blasting the holes are put down 8 ft. lower than the bank with a burden varied to suit the height of the bank and the nature of the ground, 30 to 35 ft. at the bottom being a fair average. A 6-in. bit is used. Each hole is cased to a depth of 20 ft. in starting and if the sides show a tendency to crumble the casing is extended to full depth. When a hole is complete it is sprung with 35 per cent. dynamite. The seamy and uneven nature of the ground gives the drill a tendency to drift and this causes the hole to break with a wide toe.

COINAGE IN JULY.

Coinage executed at the mints of the United States during the month of July, 1911, was as follows:

	Pieces.	Value.
Silver—		
Dimes	850,000	$ 85,000
Total silver	850,000	85,000
Bronze—		
One cent	12,120,000	121,200
Total minor	12,120,000	121,200
Total coinage	12,970,000	$206,200

Coinage for government Philippine Islands: One centavos, 800,000 pieces, value 8,000 pesos.

STREET OILING IN MADISON, WIS.

Oiling streets has been successfully employed in Madison, Wis., for the past two years. This year nearly every macadam street in the city has received a coat of heavy asphalt oil. The oil while in the tank car is heated to 150° to 170° by steam from a traction engine, and distributed by a cart with an auxiliary reservoir in the rear and six perforated pipes. Before distributing the oil, all dust is swept against the curb by hand brooms. After oiling, traffic is kept off for five to seven days and the roadway covered with sand or stone screenings. The cost last year averaged 2.2 cts. per sq. yd.

CANADIAN PACIFIC RAILWAY'S EARNINGS

While the meeting of the Directors of the Canadian Pacific Railway last Monday was not productive of news in the direction of increased dividends, new capital stock issues or action of a similar character which the market "bulls" have been predicting for a considerable time, a definite statement regarding the earnings was made after the meeting.

The most essential items concerning the earnings for the fiscal year ended June 30th are that after payment of all dividends, nearly $12,000,000 is carried forward as a surplus from railway and steamship earnings, besides which there is the sum of $6,500,000 special income from land sales and other assets, making a net surplus of $18,896,615 carried forward, or over $1,500,000 per month.

The net earnings for the first time exceeded $100,000,000.

In this year's report appeared an item "Special income from interest on land sales and from extraneous assets not included in the above, $6,602,205." No corresponding item appears in the report for the year ended June 30th, 1910, but a list given in the report which would seem to correspond thereto amounted to a total of $2,426,477. This item was accordingly used in the above table although the large increase in the corresponding figures for last year would require more explanation than appears on the surface. The net result is the essential item after all. After paying all dividends and making allowance for depreciation and various special charges the surplus carried forward is $18,-475,447, or $4,578,832 more than the previous year being an increase, as compared with the previous year of 33 per cent.

This is a splendid showing, more especially in view of the fact that last year's crop was considerably smaller than was at first hoped, and also in view of the fact that many of the American railroads showed a considerable shrinkage in earnings as compared with the previous year. After paying all charges and dividends and after making allowance for depreciation, etc., the company has been able to carry forward a surplus, over and above all charges, of one and a half million dollars per month. The fact that the Western crop this season is fully 75 per cent. greater than a year ago will exercise its influence on the earnings of the company for the current year and the company will be able to show still greater earnings than those mentioned above.

RAILROAD AND COMPANY EARNINGS.

The following are the railway earnings for the week ended August 7th:—

	1910.	1911.	Increase.
C.P.R.	$2,065,000	$2,272,000	$207,000
C.N.R.	248,200	332,550	84,350
Halifax Electric Ry. ..	5,071	5,641	570
T. & N.O. Railway ..	23,986	35,802	11,816

The total earnings of the Calgary Street Railway for July were $39,147, an increase over last year of $16,000. Total operating expenses were $15,187, and after the addition of the interest and sinking fund and the contingent account, there was still a profit of $16,739. The proportion of operating expenses to revenue is decreasing, as the cost this year was 38 per cent., while last year it was 40 per cent. The number of passengers carried was 919,325.

The Grand Trunk Railway's surplus is £263,000. The directors promise a full dividend on the first and second preferred stocks, carrying forward about £11,700. The Great Western deficit is £31,462, owing to the strike in July and August, 1910. It has been decided to carry the balance forward to next year.

COMPARATIVE COSTS OF SEWAGE PURIFICATION.

The annual reports of Matthew Gault, Superintendent of Sewers for the City of Worcester, Mass., contain interesting and valuable data on the methods and cost of purifying sewage in that city. The data given in this article are compiled from the last two annual reports.

The purification of sewage involves three distinct problems, viz.: (1) The removal and disposal of the suspended matters; (2) the oxidation of the dissolved organic matters, so that the effluent shall be non-putrescible; and (3) the disinfection of this effluent, so as to render it free from pathogenic germs. The extent of the purification required in any given case depends upon local conditions.

The City of Worcester is required, by statute, to "remove from its sewage, before it is discharged into the Blackstone River, the offensive and polluting properties and substances therein, so that after its discharge into said river, either directly or through its tributaries, it shall not create a nuisance or endanger the public health."

The first problem, the removal and disposal of the suspended matters, was effectively solved by the adoption of chemical precipitation and sludge pressing, the sludge-cake being used, mainly, for filling up a large swampy area.

As time went on it became apparent that, under existing conditions, the removal of suspended matters alone was not satisfying all of the requirements. Accordingly, steps were taken towards the solution of the second problem, the oxidation of the dissolved organic matters, by providing intermittent sand filters.

The area now available for this purpose, January 1, 1911, amounts to nearly 75 acres. Upon this area it is possible to treat an average of 40 per cent. of the organic matter of the entire sewage with very satisfactory results.

While it will probably never be essential at Worcester to take the final step of sterilization of the sewage effluent, it will undoubtedly be necessary to continue to provide means for the bacterial purification of the sewage.

The population of Worcester by the census of 1910 was 146,000. The estimated population using the sewerage system was 136,000.

The disposal works consist of sedimentation and chemical precipitation tanks, intermittent sand filters, and small sprinkler filters installed for experimental purposes. The quantity of sewage received at the purification works during 1910 averaged 14,570,000 gals. per day. Practically all the sewage was passed through the grit chambers, which collected a total of 565 cu. yds. of deposit, or approximately 0.11 cu. yd. per million gals. of sewage. This deposit was hauled to a nearby gravel pit.

The strongest sewage is selected for sand filtration up to the capacity of the area provided. The remainder is treated by chemical precipitation, with the exception of a relatively small amount applied to the sprinkler filters. The quantity of sewage treated in each way during 1910 is as follows:—

	Million Gallons. Total.	Daily.	Per cent. of total.
Chemical precipifation ...	3,580	9.81	67.3
Sand filtration	1,722	4.72	32.4
Experimental sprinkler filters	15	0.04	0.3

Chemical precipitation required the use of 989 lbs. per million gals. of sewage treated. The results of this treatment, measured by albuminoid ammonia, show a removal of 77.8 per cent. of the suspended organic matter. The sludge from chemical precipitation, amounting to 15,946,000 gals., was pressed and 13,217 tons of cake were formed, which were hauled by motor car to a sludge dump.

The area of sand filters available in 1910 was 64.7 acres, and the quantity applied averaged 73,000 gals. per acre per day. Preliminary to filtration the crude sewage is passed through a tank which provides a period of about 30 minutes for sedimentation. From the tank there was removed 6,850,000 gals. of sludge containing 1,071 tons of dry solid matter. This sludge was pumped to the sludge-beds.

The total purification affected by this treatment in terms of albuminoids ammonia amounts to 87.3 per cent. of the total organic matter and 64.4 per cent. of the dissolved organic matter.

The deposit removed from the surface of the beds has amounted to 17,155 cu. yds., which is equivalent to 265 cu. yds. per acre and 10.0 cu. yds. per million gallons of sewage filtered. The cost of cleaning was approximately $4,700, or 27.4 cents per cu. yd.

Before the sewage flows upon the beds it passes through a grit chamber 40 ft. long by 10 ft. wide, by 10 ft. deep, and thence through a settling tank 167 long, by 40 ft. wide, by 7 ft. deep. The sewage is applied to the beds at a rate such that a bed is from 2 to 6 hrs. in filling. Each bed is used 1 to 4 times weekly.

The surface of the beds is raked occasionally with a wire-tooth horse weeder which loosens up the top half inch of the filter media. The deposit on the surface of the beds is raked up into small piles about 4 ft. apart in the fall, and these piles are left in the beds during the winter to assist in holding up the ice. The deposit is again raked up in piles in the spring and at that time the deposit is removed from the beds.

Table I. gives the cost of maintaining the Worcester sewage disposal works from 1890 to 1910, inclusive. Table II. gives the results of sludge pressing from 1899 to 1910, inclusive.

TABLE I.—COST OF MAINTAINING SEWAGE DISPOSAL PLANT.

Year	Amt. of sewage treated in gals	Cost	Cost per mil. gals.	Pop.	Cost per capita
1890........	391,000,000	$47,919.60	$122.55	84,655	$0.56
1893........	1,795,000,000	24,103.23	13.43	92,870	0.26
1896........	5,840,000,000	43,264.23	7.41	102,400	0.42
1908........	5,615,000,000	49,226.52	8.77	138,000	0.36
1909........	5,265,000,000	49,892.31	9.48	142,200	0.35
1910........	5,317,000,000	49,908.67	9.39	145,986	0.34

Note.—The costs here given represent the net cost of maintenance, but do not include expenses for litigation and land damages. The costs for 1895-1899 include considerable money spent on construction, but which cannot be separated from maintenance charges because both items were kept in the same account. This is also true for the figures given for 1890. The total population is estimated on the basis of a uniform per cent. increase per annum, between the census returns.

TABLE II.—RESULTS OF SLUDGE PRESSING.

	Sludge		Press Cake		Solids			Cost of Operation		
Year.	Thousand gallons pressed.	Per cent. solids.	Tons cake.	Per cent. solids.	Tons solids.	Tons per million gallons sewage treated.	Pounds lime added per thousand gallons sludge pumped.	Total.	Per million gallons sewage treated.	Per ton solids.
1899..............	52,600	2.99	33,101	26.1	6,606	1.13	11.1	$ 30,683.73	$4.92	$4.64
1901..............	24,920	5.25	20,152	27.0	5,450	1.74	20.0	18,477.59	5.89	3.39
1906..............	15,761	8.09	16,959	31.3	5,310	1.25	52.2	20,171.91	4.74	3.80
1910..............	12,244	8.20	12,867	31.6	4,182	1.17	53.5	16,208.41	4.53	3.88

COAL SAMPLING BY PURCHASER AND DEALER.

That accurate methods in sampling coal deliveries will give nearly the same results from analyses by both the purchaser and the dealer, is a point made in a recent paper by Dwight T. Randall.

In illustration, the following results are given of coal sampled and analysed by both parties from the same barge:

	Sample taken by representative of consumer.	Sample taken by representative of coal dealer.	Difference.
Ash in dry coall......	10.48	10.14	0.34
B.t.u. in dry coal.....	14,099	14,155	56

Another case shows that results will check reasonably well when samples are properly taken, and also that the results are not always as unfavorable to the coal dealer as he frequently assumes. A coal dealer employed a disinterested party to sample coal from a barge as it was unloaded, and a sample was taken by the consumer at his plant for one week. These samples were worked down and analysed by separate laboratories with the following results:

	Sample No. 1. Taken by representative of coal company.	Sample No 2. Taken by consumer.	Difference.
Ash in dry coal	5.96	5.67	0.29
B.t.u. in dry coal	14,803	14,866	63

Such results can be obtained only when samples are taken and prepared for the laboratory by careful men who will follow instructions absolutely. It takes time to break down a sample properly and few laborers who are detailed to do this work realize the importance of the work, and a short or easy method is frequently used which may secure results far from right.

The fact that there may be small variations from the true heating value just as there may be in weight of the coal and that these variations are as fair to the buyer as to the seller, must be recognized. They will tend to offset each other during a period of a year. It is better to know within one per cent. of the weight and of the heating value of coal than to have no information about it. It is possible to determine both with greater accuracy if only reasonable care is used.

A TREATISE ON RETAINING WALL DESIGN.

THE SECTION MODULUS—DEFINITION OF MOMENT OF INERTIA AND RADIUS OF GYRATION.

By J. H. Everest, C.E.

(Continued from Last Week.)

The section modulus varies according to the section employed, for a rectangular section it is $\frac{bd^2}{6}$; we will investigate the conditions as to how this value has been arrived at.

Now the moment of inertia for a rectangular section, generally written $I = \Sigma a y^2$, Σ signifyng summaton, a, area of any individual fibre and y, distance of centre of gravity of portion from the neutral axis. In other words in the for- $I=\Sigma a y^2$, it is first supposed that the section is divided into several horizontal layers or fibres, the area of each one being separately calculated and then multiplied into the mean distance squared from the neutral axis, finally summing up the results thus obtained. It is readily seen that this is not necessary, as there must be a mean distance for the whole section, which when squared and multiplied into the whole area A, will give the required moment of inertia as before. This mean distance is termed the radius of gyration and is equal to $\sqrt{\frac{I}{A}}$; in which I=moment of inertia of section and A whole area.

Again referring to the section modulus $\frac{bd^2}{6}$; the resistance figure for a rectangular section is shown in plans reproduced. Before proceeding any further, it may be well to know what is meant by the term resistance figure or resistance area.

Resistance Area.

A misconception seems to exist regarding the meaning of this term. The fact that it is called resistance area, and further that it only takes up a portion of the whole area, seems to convey the idea that useless material is divided from active material.

This is by no means the case; if the resistance figure were subjected to a uniform stress the amount of which equals that on the extreme fibre, the result would be the same as if the whole section were subjected to a varying stress commencing from the neutral axis and reaching a maximum at the extreme fibre. Now to consider the section modulus. It is first necessary to find the centre of gravity of each triangle.

this is equal to $\frac{2}{3}\frac{d}{2}$; in each case. The area of the triangle equals $\frac{1}{2}$ base multiplied by perpendicular height, or $\frac{1}{2}b \times \frac{1}{2}d = \frac{bd^2}{4}$; and section modulus equals area of triangular resistance figure, multiplied by distance apart of centres of gravity. It will therefore be seen that the section modulus for a rectangular section is $\frac{bd}{4}$ multiplied by distance apart of centres of gravity which equals $\frac{2}{3}d$

$$\therefore \text{ Section Modulus } M = \frac{bd}{4} \times \frac{2}{3}d = \frac{bd^2}{6}$$

By the aid of the section modulus we may compute the moment of inertia by multiplying it by the distance of extreme fibre from the neutral axis, which for a rectangular section equals $\frac{d}{2}$; thus:—

$$\text{Moment of Inertia} = \frac{bd^2}{6} \times \frac{d}{2} = \frac{bd^3}{12} = I$$

Therefore it is evident that for rectangular sections:—

$$M = \frac{bd^2}{6}; \text{ and } I = \frac{bd^3}{12}$$

The application of these formulae in practical design will be considered later. Before attempting the design of retaining walls, we will consider the vexed question of earth pressure and the effect of friction.

(To be Continued.)

TOOTHLESS SAWS FOR CUTTING STEEL.

The employment of high-speed revolving disks of mild steel for cutting hard steel is coming into general use. The disks are preferably made of boiler plate quality and are about a quarter of an inch thick. They revolve with a peripheral speed of as much as 20,000 feet a minute. One of these disks will cut through a heavy channel section of hard steel. 12 by 6⅜ inches, in fifteen seconds.

It appears to act by local fusion. The very high speed causes thousands of inches of surface to impinge in rapid succession on the metal undercut. so that its temperature at the point of contact, becomes very high, although the disk, owing to the large surface area, remains relatively cool. All its frictional energy is concentrated on an extremely small area of contact. The work is done so quickly that the heat has no time to spread to the metal undercut, and the sides of the cut portion are only a little warmed.

WATER PURIFICATION BY OZONE.

At the end of 1910 the municipal authorities of St. Petersburg inaugurated a public supply of ozonized water with a view to avoiding the cholera and typhoid epidemics attributed to the use of impure water. The plant employed includes elevated pumps, accelerated filters and the actual sterilizer towers; its capacity is 11,000,000 gallons of pure water per diem. The Howatson filtration process is adopted, a solution of aluminum sulphate being used to effect a preliminary clarification of the water. Eight reservoirs and thirty-eight filters are in use. From the preliminary filters the water possesses to sterilizing towers where it is mixed intimately with ozonized air by being sprayed in by special pumps. Siemens ozone producers are employed, 127 sets being in use; in this apparatus the air is submitted to a 7,000 v. 500 cycles per second discharge. The requisite energy is supplied by three steam-driven dynamos, each of 150 h.p. By the above means the brackish water of the Neva is rendered potable and free from bacteria; the cost of treatment is very moderate and the hygienic value of the process is incalculable.

MUCH TO LEARN IN PORCUPINE YET.

The latest report on the Porcupine gold area is from Mr. A. G. Burrows, of the Ontario Bureau of Mines. He deals with the situation of the camp, its topography, and gives some details of the early examination of the area and early prospecting. A long chapter is devoted to the geology of the camp and something is said of the relation of quartz veins to granite. Information is given respecting the Dome, West Dome, Preston East Dome, Hollinger, Rea, Armstrong McGibbon, Scottish Ontario, Vipond and Foley-O'Brian mines and the Powell claims. A short summary is given of the waterpowers in the Porcupine region.

Dealing with the character of the gold bearing deposits, Mr. Burrows states that the occurrence of gold at Porcupine is associated with the quartz solutions which circulated through the fissures in the Keewatin and Huronian series. "The irregular fissuring has produced a great variety of quartz structures, varying from the tabular, though often irregular or lenticular, vein which may be traced several hundred feet, to mere veinlets, often only a fraction of an inch in width and a few feet in length, which ramify through a rock that has been subjected to small irregular fissuring. This latter variety is well illustrated in the fissuring of ankerite bands, so characteristic of many of the gold deposits of Porcupine. Irregular and lenticular bodies of quartz often occur which may have a width of ten or twenty feet, but which die away in a distance of fifty feet. Again there are dome-like masses of quartz which are elliptical or oval in surface outline, but whose underground extension has not been examined closely.

"In some parts at least these masses can be seen in contact with underlying rocks at a low angle, which would suggest that they are broad lenticular masses which have filled lateral fissures in the country rock. The most conspicuous dome masses are those of the Dome property where the two largest are about 125 feet by 100 feet. A fissure may be vertical and regular at some points. At others it may incline at a lower angle to the horizontal or take on a more or less lenticular form.

"The relationship of the strike of the veins to that of the enclosing rock is often difficult to determine, since generally along the veins there has been shearing of the country rock which may conform to the general direction of the strike of the veins. However, by determining numerous strikes in the schist away from the veins, it is seen that the majority of them are inclined to the direction of strike of the enclosing rocks. In dip the veins vary from vertical to nearly horizontal. In No. 1 shaft of the Hollinger the vein is practically vertical, while a series of narrow quartz veins, 6 to 18 inches wide on the Lindburg claim, have a dip at the surface of only 20°. The prevailing dip of the schist in the Porcupine area is to the north at a high angle, and frequently the veins dip distinctly to the south across the cleavage of the schist. While it is apparent that most of the deformation of the country antedates the vein formation, nevertheless there is a decided tendency in many cases for the fissuring to be influenced by the direction of schistosity, which is also a direction of weakness; hence we find veins having a more or less lenticular structure the strike of which closely corresponds to that of the country rock.

"While gold-bearing veins occur over a wide area and are often isolated, it is seen, from a number of those already discovered, that they occur in groups along certain lines. For instance, in Tisdale township there are at least three distinct areas where the fissuring has been most pronounced. One such area extends from the southeast end of Miller lake, on lot 11 in the first concession, in a northeasterly direction for three miles, and includes such veins as the Miller-Middleton, Hollinger, McIntyre and Connell or Rea, and in addition many others with visible gold. The average strike of the veins here is northeast-southwest. Another series, including the Davidson, Crown-Chartered, Armstrong-McGibbon, and Bannerman (in Whitney), occurs in the northeast part of the township in the fifth concession. The general direction of the veins is east and west. Again in the southeast part of the township is a group including the Foster, Dome and Dome Extension, with general strike somewhat south of west. Similar groupings could be mentioned in other parts of the area.

"In these disturbed zones the country rock is generally schistose in character. At the Dome mine the disturbed area has a width of about 600 feet, in which there are numerous narrow quartz veins in addition to large irregular quartz masses.

"Well defined, disturbed zones occur in the fifth concession of Tisdale. In this locality the main rock is a light greenish, fine-grained, rather massive greenstone. This greenish rock is itself not much fissured, but here and there through it are bands of rusty-weathering carbonate, which is generally schistose, striking east and west. I think that much of the carbonate associated with this greenstone is of secondary origin. It is possible that the shattering and fissuring of the greenstone in an east and west direction may have caused a deposition of migrating carbonate solutions, partly filling fissures and partly replacing the greenstone. These carbonate bands were later fissured, and gold-bearing quartz solutions deposited in them. The fissuring of the carbonate is generally irregular, and hence we find veins with steep or low dip striking with the schist and across it. This irregular series of veins is seen at the Crown-Chartered and Armstrong-McGibbon properties. Where the veins are small, it becomes necessary to mine both the carbonate and the intersecting quartz veins. Gold often occurs in the carbonate near the contact with the quartz veins, as well as in the quartz.

"While the quartz is considered to carry the gold, it was noted at many properties that the metal occurs in greatest quantity along certain lines which give a streaky character to the ore. On the surface these streaks are rusty due to the oxidation of pyrites, while at depth they are dark gray or greenish in color.

"Thin sections of quartz from the main Hollinger vein show grains of quartz with irregular outline, which often contain liquid and gas inclusions. There has also been much secondary pressure, indicated by strain shadows or wavy extinction, and along lines of slip or fracture planes there has been much crushing of the quartz to finer grains. In these crushed areas are secondary minerals like calcite, sericite, etc., while iron pyrites is also present in cubical form and has evidently crystallized, subsequent to the crushing.

"Some thin sections from the Rea mine main vein also show much secondary crushing along lines. Calcite and sericite are present in the crushed quartz generally in linear arrangements, and in addition there are several rough crystal outlines of free gold which were formed subsequent to the crushing.

"These fine dark streaks may have resulted from a solidification and shrinkage of the quartz forming filmy cracks which may have become slip or crushing planes along which the richer gold-bearing solutions were deposited at a later period.

"These minute dark streaks in the quartz are frequently slickensided, and this character may often be seen in hand specimens, as from the Rea or Vipond mines.

"It should be noted that where cracks or fracture planes have been produced in a quartz vein and subsequently filled by minerals from solution, secondary quartz can be distinguished with difficulty, if at all, from the original quartz. Hence it is not always possible to say whether visible gold in such a vein occurs in the original or in secondary quartz.

"Carbonates of lime, magnesia and iron occur with the quartz in practically all the veins in the area. This material may have been absorbed from the wall rock, which is frequently dolomite or rock impregnated with dolomite or calcite. Fragments of country rock are often included in the veins. Veinlets of clear calcite occasionally cut the quartz veins.

"The distribution of the gold is generally irregular, occurring along one or both walls, while other portions of the vein may be very low grade. Most spectacular showings occur on many properties, but these are limited to portions of the veins. Considering the irregular character of certain veins and the quantity of country rock which will need to be mined, the ore must be considered low grade.

"Iron pyrites occurs in massive and crystallized forms, somewhat sparingly in most of the veins. Cubes of pyrites are frequently abundant in the enclosing rocks, especially where sericitic or dolmitic schist occur. A sample of cube pyrites was separated from the schist, obtained from a shaft of a principal property, and an assay gave a gold content of $10.40 per ton.

"Copper pyrites, galena, zincblende and pyrrhotite are found in some veins in very minor quantity. Sulphide of silver, argentite, occurs in association with the gold on the Powell property in Deloro township.

"It will be seen from an examination of the ore from most of the properties that it is largely free milling, while the concentrates should be amenable to cyanide treatment.

"Little is said in this report as to actual values of properties, since their sampling is the prerogative of their owners. Many samples were taken for assay, rather for the determination of the distribution of the gold, which was found to be irregular and to be associated with the secondary fracturing of the quartz (and schist) in many cases. The determination of the value of properties is a matter requiring considerable development accompanied by extended sampling and mill tests."

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CONSTRUCTION NEWS SECTION

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

TENDERS PENDING.

In Addition to Those in this Issue.

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

Place of Work.	Tenders Close.	Issue of.	Page
Montreal, P.Q., automobile fire apparatus	Aug. 31.	Aug. 17.	211
Ottawa, Ont., ties and switch ties	Aug. 31.	Aug. 17.	211
Ottawa, Ont., station at Truro, N.S.	Aug. 25.	Aug. 17.	211
Ottawa, Ont., wharf, Papineauville, Que.	Aug. 23.	Aug. 3.	151
St. Jerome, P.Q., distributing system	Aug. 28.	Aug. 17.	211
Toronto, Ont., government house	Aug. 22.	July 27.	121
Toronto, Ont., steel conduit	Aug. 23.	Aug. 17.	211
Victoria, B.C., bridge work	Aug. 31.	Aug. 3.	152
Victoria, B.C., construction of bridge	Aug. 31.	Aug. 3.	152
Whitehead, Man., bridge and abutments	Aug. 25.	Aug. 3.	68

TENDERS.

Ottawa, Ont.—Sealed tenders will be received until 4 p.m., on Wednesday, September 6th, 1911, for the construction of a breakwater at Feltzen South, Lunenburg County, N.S. Plans, specifications, etc., can be seen and forms of tender obtained at the Department of Public Works and at the offices of C. E. W. Dodwell, Esq., District Engineer, Halifax, N.S.; E. G. Millidge, Esq., District Engineer, Antigonish, N.S., and on application to the Postmaster at Feltzen South, N.S.

Ottawa, Ont.—Sealed tenders will be received until 4 p.m., on Tuesday, September 12th, 1911, for the construction of an extension to breakwater at Kelly's Cove, Yarmouth County, N.S. Plans, specification, etc., can be seen and forms of tender obtained at the Department of Public Works and at the offices of C. E. W. Dodwell, Esq., District Engineer, Halifax, N.S.; E. G. Millidge, Esq., District Engineer, Antigonish, N.S., and on application to the Postmaster at Kelly's Cove, N.S.

Ottawa, Ont.—Sealed tenders will be received at this office until sixteen o'clock on Friday, September 15th, 1911, for a branch railway line. Plans, profiles, specification, etc., can be seen at the office of the Chief Engineer of the Department of Railways and Canals, Ottawa; at the office of the Chief Engineer of the Intercolonial Railway, Moncton; and at the office of the Board of Trade, Halifax.

Ottawa, Ont.—Tenders will be received until September, 13th, 1911, for the construction of a breakwater and dredging at Port Stanley, Elgin County, Ontario. Plans, specification and form of contract can be seen and forms of tender obtained at this department and at the offices of Mr. H. J. Lamb, Dist. Engineer, London, Ont.; J. G. Sing, Esq., Dist. Engineer, Confederation Life Bldg., Toronto, Ont., and on application to the Postmaster at Port Stanley, Ont. R. C. Desrochers, Secretary, Dept. of Public Works, Ottawa. (Advertisement in this issue.)

Ottawa, Ont.—Tenders endorsed "Tender for St. Peter's Canal Improvements," will be received until Tuesday, September 12th, 1911, at the office of L. K. Jones, secretary, Dept. of Railways and Canals, Ottawa. (Advertisment in this issue.)

Ottawa, Ont.—Tenders for the construction of a breakwater at West Advocate, Cumberland County, N.S., will be received until August 30th, 1911. Plans, specifications and form of contract can be seen and forms of tender obtained at the offices of C. E. W. Dodwell, Esq., Dist. Engineer, Halifax, N.S.; E. G. Millidge, Esq., Antigonish, N.S., on application to the Postmaster at West Advocate, N.S., and at the office of R. C. Desrochers, Secretary, Dept. of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received until September 11th, 1911, for the construction of a breakwater at Thessalon, District of Algoma, Ont. Plans, specification and form of tender can be obtained at the offices of J. G. Sing, Esq., Dist. Engineer, Confederation Life Bldg., Toronto, Ont.; H. J. Lamb, Esq., Dist. Engineer, London, Ont., on application to the Postmaster at Thessalon, Ont., and at the office of R. C. Desrochers, Secretary, Dept. of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received until September 13th, 1911, for the construction of a landing pier at Wheatley, Kent County West, Ont. Plans, specifications, etc., to be had at the offices of J. G. Sing, Esq., Dist. Engineer, Confederation Life Bldg, Toronto, Ont.; H. J. Lamb, Esq., Dist. Engineer, London, Ont.; on application to the Postmaster at Wheatley, Ont., and at the office of R. C. Desrochers, Secretary, Dept. of Public Works, Ottawa.

Ottawa, Ont.—Tenders will be received until September 6th, 1911, for the construction of a breakwater at French River, Victoria County, N.S. Plans, specifications and form of tender can be had at the offices of E. G. Millidge, Esq., Dist. Engineer, Antigonish, N.S.; C. E. W. Dodwell, Esq., Dist. Engineer, Halifax, N.S.; on application to the Postmaster at Breton Cove, North Shore, Victoria County, N.S., and at the office of R. C. Desrochers, Secretary, Dept. of Public Works, Ottawa.

Toronto, Ont.—Tenders will be received up to noon on Tuesday, August 29th, 1911, for the construction of a sewer on Curzon street, from Myrtle avenue to 530 feet south. Specifications may be seen and forms of tender obtained at the office of the City Engineer, Toronto.

Toronto, Ont.—Sealed tenders will be received until noon on Tuesday, the 5th September, 1911, for the library metal shelving and fittings required in connection with the library addition to the Ontario Government buildings, Queen's Park. Plans, specifications obtained at the offices of George W. Gouinlock, architect, 1108 Temple Building, Toronto.

Toronto, Ont.—Tenders will be received until Tuesday, September 5th, 1911, for the construction of one steel steam screw tug. G. R. Geary (Mayor), Chairman, Board of Control, City Hall, Toronto. (Adv. in the Can. Eng.)

Toronto, Ont.—Tenders will be received until September 5th, 1911, for the supply of 600 feet of 16-inch steel riveted or lap-welded pipe and 420 feet of 12-inch welded steel pipe. G. R. Geary (Mayor), Chairman, Board of Control, City Hall, Toronto. (Adv. in the Can. Eng.)

Toronto, Ont.—The time for receiving tenders for the supply of rail accessories has been extended from August 31st, 1911, to September 7th, 1911. G. R. Geary (Mayor), Chairman, Board of Control, Toronto. (Advertisement in this issue.)

Brantford, Ont.—Sealed tenders will be received until noon of Saturday, September 2nd, 1911, for the construction of a proposed residence for nurses in connection with the John H. Stratford Hospital at Brantford. Plans and specifications may be seen at the office of the Associate Architects, Messrs. Taylor & Taylor, Colborne Street, Brantford.

Brantford, Ont.—Tenders for the construction of a steel highway bridge will be received until Wednesday, August 30th, 1911. Tenders to be addressed to Chas. Hartman, Esq., Chairman of the Board of Works, care of the City

Clerk, Brantford, Ont. T. Harry Jones, City Engineer. (Advertisement in this issue.)

Winnipeg, Man.—Tenders will be received by J. G. Sullivan, Assistant Chief Engineer, C.P.R., and N. E. Brooks, Division Engineer, C.P.R., Calgary, up to noon, August 25th, 1911, for the construction of concrete substructure for bridges, 53.7 and 65.6, Crow's Nest Subdivision.

Winnipeg, Man.—Tenders addressed to the Chairman, Board of Control, will be received at the office of the undersigned until September 25th, 1911, for supply of the following fire department apparatus, namely:—2-60 h.p. motor hose wagons; 1-85 ft. aerial ladder truck; 30 fire alarm boxes, complete. Specifications and forms of tender may be obtained at the office of the Chief of the Fire Department, Central Fire Station. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders for the manufacture, delivery and installation of underground cable for the Electrical Distribution System, will be received until August 28th, 1911. All particulars may be obtained at the office of the general manager of the Light, Power Department, 449 Main Street, Winnipeg. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Winnipeg, Man.—Tenders for the manufacture and delivery f.o.b. Winnipeg, of six potential regulators. Particulars governing conditions of tenders, etc., to be had at the office of the Power Construction Department, Carnegie Library Building. M. Peterson, Secretary, Board of Control Office, Winnipeg.

Dauphin, Man.—Sealed tenders will be received by the secretary-treasurer of the town until 8 p.m. on Tuesday, September 5th, 1911, for constructing the following works: —Contract "I"—Dam and gate house in Riding Mountains, for waterworks reservoir. Contract "P"—Substructure sewage pumping station in Dauphin. Plans may be seen at Dauphin or at the offices of Messrs. Chipman & Power, engineers at Toronto and Winnipeg.

Weyburn, Sask.—Sealed tenders will be received at this office until 4 p.m., on Tuesday, September 5th, 1911, for the construction of a public building. Plans, specifications and form of contract may be seen and forms of tender obtained at the office of Mr. J. E. Cyr, Superintendent of Public Buildings for Manitoba; Post Office Building, Winnipeg, Man.; and at the Post Office, Weyburn, Sask.

CONTRACTS AWARDED.

Halifax, N. S.—The Nova Scotia Construction Co., a company with headquarters in this city, has been awarded the contract by the Dominion government for a breakwater at Brooklyn, Shelburne county, to cost in the vicinity of $180,000. The same concern has also secured the building of a branch line in Quebec for the C.P.R., and the construction of a power house for the Windsor Hotel, Montreal.

Brooklyn, N. S.—Breakwater.—Contractors:—The Nova Scotia Construction Company, Ltd., of Sydney, C.B.

Moncton, N.B.—Dr. C. A. Murray and John A. Lea have been awarded a contract by the Grand Trunk Pacific commissioners to erect stations and other buildings on the G.T.P. between Moncton and Beaver Brook. The contract, it is rumored, will mean an expenditure of well on to $150,000. The work to be started at once.

The contract for the construction of a public building at Rock Island, Que., has been awarded to Mr. N. A. Beach, of Georgeville, P.Q., at $17,750.

Montreal, P. Q.—The tender of the Northern Electric Company to install a police alarm system throughout Westmount was accepted at $9,000 by the municipal council.

The Dominion Bridge Company will do the steel work on the new fire station which amounts to $4,420, and the tender was accepted of Martin J. Quigley for plumbing on the station, amounting to $1,080.

Ottawa, Ont.—Experimental Farm.—Tobacco Curing Barn.—Contractor:—S. A. Matte, Ottawa,—$6,500.

North Toronto, Ont.—The Excelsior Construction & Paving Co. have received the contract for providing and laying sewer pipe with necessary manholes and junctions, east of Bayview Avenue. Contract price, $6,122.40.

Hamilton, Ont.—Messrs. David Dick & Sons of Welland, Ont., have secured the construction work in connection with an addition to be made to the plant of The International Harvester Co. The structure will be of reinforced concrete, and cost approximately $250,000.

Guelph, Ont.—The construction work in connection with a factory for the Independent Fire Co., has been awarded to Messrs. P. H. Secord & Sons, of Brantford. The amount is reported to be $47,000.

Guelph, Ont.—Messrs. Rutherford & Paten, of St. Catharines, have been awarded the contract for a new concrete bridge across the river at Heffernan street. The price named is $7,250, and was the lowest of three tenders.

London, Ont.—The contract to erect a bridge on Lot 27, Con. 8-9, has been awarded to J. G. Fletcher for $402.

London, Ont.—The hospital trustees have awarded the contract for new motors to the Canadian General Electric Company at $1,655. The Westinghouse Company bid $1,695. The tenders do not call for installation, and local contractors will be asked to bid on this work.

Harriston, Ont.—Mr. Charles Martin, of Harriston, has been awarded the contract for the construction of a municipal drain in the township of Minto, at a cost of $5,980.

Sault Ste. Marie, Ont.—The contract for the construction of a single track extension from Hobon on the C.P.R., 194½ miles from the Soo, to Hobon on the National Transcontinental Railway, a distance of 101 miles, has been awarded to the Superior Construction Co., of Sault Ste. Marie, Ont. The principals in the contracting firm are Mr. J. D. McArthur, Railway Contractor, and Mr. T. J. Kennedy, formerly General Superintendent of the A.C. Railway. The work of construction will commence at once, and engineering parties are now being organized. The outlay involves some $1,600,000 estimate for construction, and complete ready for operation about $3,000,000.

St. Vital, Man.—The contract for the new paved highway from St. Boniface to a point opposite the site of the new Agricultural college in the parish of St. Vital, was awarded recently to the Bitulithic and Contracting Co., of Winnipeg. St. Vital is on the outskirts of Winnipeg.

Saskatoon, Sask.—Mr. H. Weston has let the contract for his new four-storey building to be erected on the south-east corner of 2nd avenue and 22nd street. George Archibald, of Winnipeg, is the contractor. The cost will be in the neighborhood of $60,000.

Arcola, Sask.—The tenders received for the erection and completion of an addition to the school building at Arcola were unsatisfactory and the board decided not to let the contract until next spring. No tenders were accepted.

Nanaimo, B.C.—The city council at its regular meeting awarded the contract to the El-Oso Company of Vancouver, who are to pave the business streets of the city with a material consisting of asphalt and concrete.

Vancouver, B.C.—Mr. W. H. Chase, of this city, has been awarded the contract for constructing the new wharf proposed by the Great Northern Railway Company for the foot of Campbell avenue, and it is expected that work will commence at once. A sub-contract for approximately 3,000 feet of creosoted piles and also the bracing, has already been let to the Dominion Creosoting Company.

The contract for the construction of a line on the C.N.R. from the Yellowhead to Kamloops, a distance of 250 miles, mostly in the mountains, has been awarded jointly to the Northern Construction Company and the Cowan Construction Company, and subcontracts are to be awarded in the immediate future from general offices to be opened in Vancouver.

AGENCIES WANTED.

A firm in England, makers of a much used and well-known time recorder is eager to hear from firms in Canada who are prepared to push their sale in this country. Those interested will secure further information by addressing "Recorder," Canadian Engineer.

An engineering firm in London, England, makers of concrete mixers, sheet steel piling, sewage washing machinery, and tar macadam mixers would like to hear from firms in Canada with a view to an agency being established. Address "Piling," Canadian Engineer.