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The Canadian Engineer

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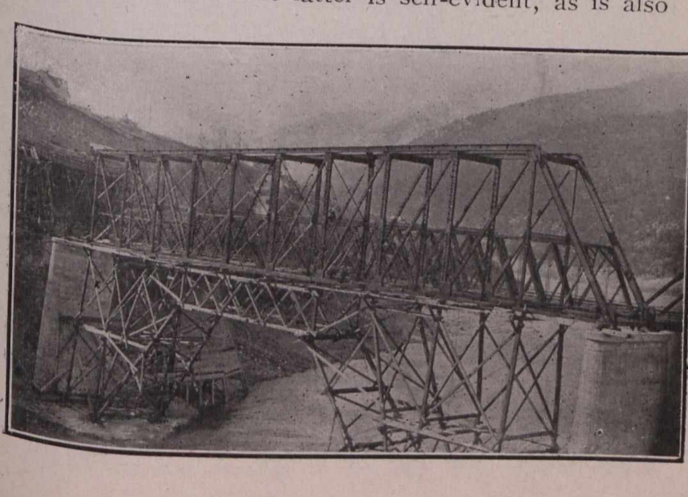
BRIDGE ACROSS THOMPSON RIVER, LYTTON, B.C.

A FEW ILLUSTRATIONS AND A SHORT DESCRIPTION OF THE CONSTRUCTION OF THE NEW BRIDGE COMPLETED IN JUNE, 1914, BY THE PROVINCIAL GOVERNMENT, AND SPANNING THE THOMPSON RIVER AT LYTTON, B.C.

IN August of last year, the government of British Columbia commenced the construction of a bridge, which was designed by E. A. Stone, M. Can. Soc. C.E., M. Inst. C.E., Consulting Engineer, Vancouver. The structure was erected under the supervision of J. E. Griffith, Deputy Minister and Chief Engineer of the Provincial Department of Public Works, and was completed in June, 1914. It crosses the Thompson River, just above the junction with the Fraser, at a site lying between that of the old government's wooden bridge and the crossing of the Canadian Northern Railway. Fig. 1 illustrates the former structure and also shows in contrast the old and new bridges. The superior excellence in the appearance of the latter is self-evident, as is also the added height of level, that of the new bridge being 40 feet above that of the old.

The contract for both the supply of the material for the sub-structure of the bridge as well as for the entire construction was awarded by the government to the Graff Construction Company. The material used was concrete, and of that 2,000 yards were required. This concrete rests on a rock foundation, which is dry at extreme low water; and was deposited by means of buckets suspended from a cable running across the river, as shown in the

Fig. 1.—Old and New Bridges in Contrast.



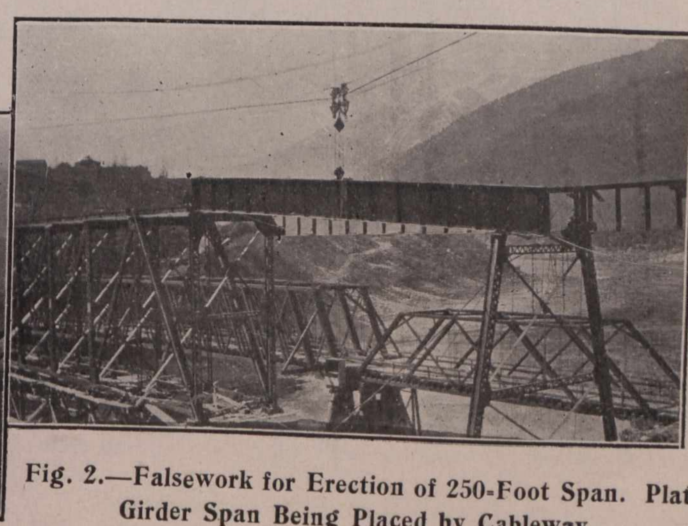


Fig. 2.—Falsework for Erection of 250-Foot Span. Plate Girder Span Being Placed by Cableway.

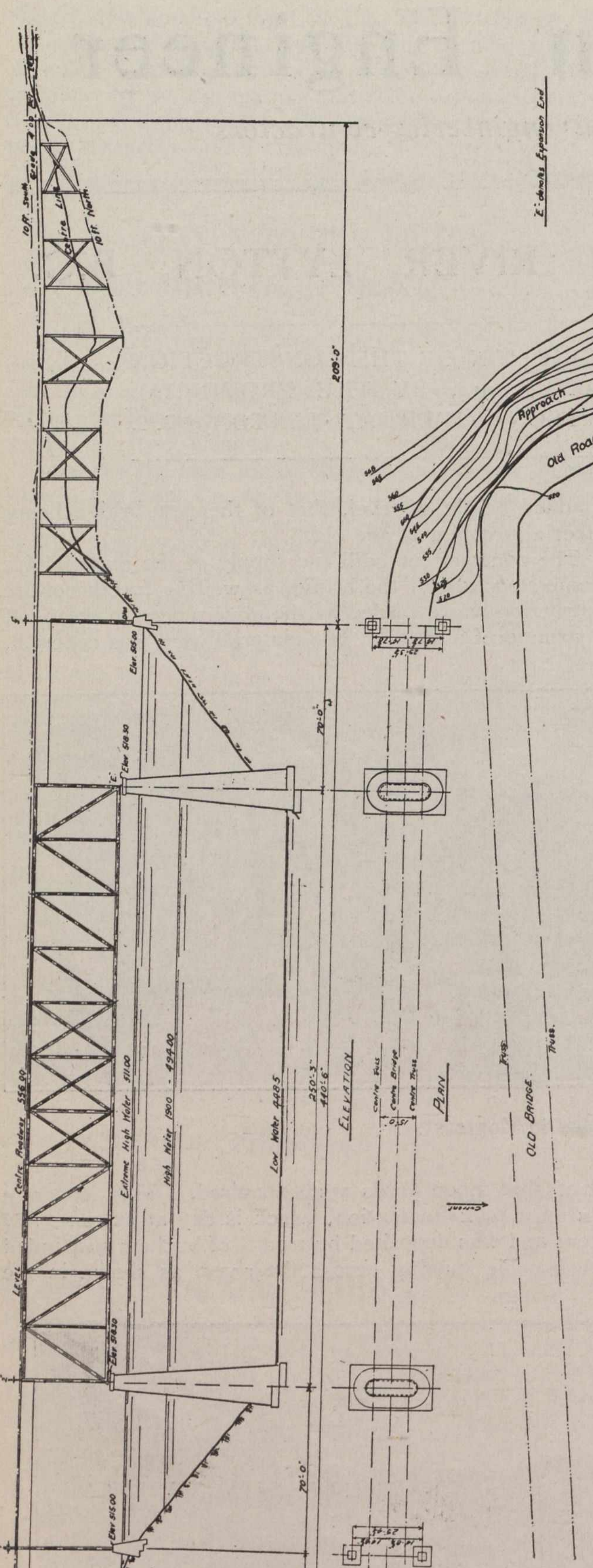


Fig. 3.—General Design of New Provincial Government Bridge at Lytton, B.C.

first and second sections of Fig. 5. The concrete was mixed to a consistency of 1 : 3 : 5, and, when completed, made a sub-structure of both satisfactory strength and very creditable appearance.

Fig. 3 shows the general plan of the new bridge as proposed and constructed; and Fig. 4, sections of the concrete abutments carrying the main truss span and of the trestle forming the approaches. As may be seen in the third section of Fig. 5, which indicates the progress made upon the south pier of the bridge by January 19, 1914, a timber trestle approach, 209 feet in length together with a similar length of grading, had to be built on the southeastern bank of the river. The concrete piers of the abutments which carry the main truss span of the bridge are 70 feet above low water, the distance of the resting surface of the truss above the extreme high-water level being 7½ feet. The large truss span resting upon these piers is 250 feet in length and 35 feet in depth (Figs. 1 and 2); while there are also two 70-foot plate girder spans, one on either side of the main section, and in addition a 50-foot plate girder span carried on steel

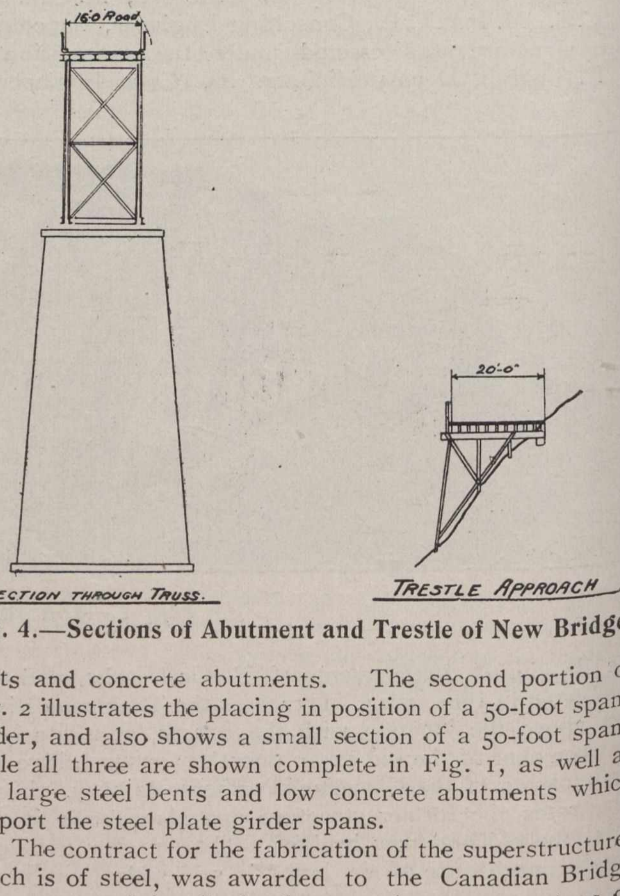


Fig. 4.—Sections of Abutment and Trestle of New Bridge.

bents and concrete abutments. The second portion of Fig. 2 illustrates the placing in position of a 50-foot span; girder, and also shows a small section of a 50-foot span; while all three are shown complete in Fig. 1, as well as the large steel bents and low concrete abutments which support the steel plate girder spans.

The contract for the fabrication of the superstructure, which is of steel, was awarded to the Canadian Bridge Company; and in all, for bents and spans, 215 tons of material were required. The bridge was so designed that the combined strength of the concrete and steel work would be capable of carrying a live load of 75 pounds to the square foot on the 250-foot truss and 100 pounds to the square foot on the 70- and 50-foot spans, together with a concentrated load of a 16-ton road roller.

The roadway of the bridge is 16 feet in width and has been constructed of 4-inch plank protected on either side by a 4-foot hand railing with posts 7 feet 7½ inches apart. The roadway plank is supported on 6-inch joists of varying depth, according to camber, on steel I-beam stringers, while a crowning, one inch thick, has been applied to the top of the floor.

By September 1, 1913, the Graff Construction Company, contractors for the bridge, had advanced to the stage indicated in the first section of Fig. 5. The north abutment was in place; the cable-way erected, and the bucket had commenced the depositing of the concrete mixture for the formation of the piers; in October, this abutment was completed and the pedestals for the steel

of the bridge work in progress in Fig. 2 were taken on April 15 and April 22, the former portion of the illustration showing the falsework used in the erection of the main span, perhaps the most interesting feature in connection with the building of the bridge, the falsework

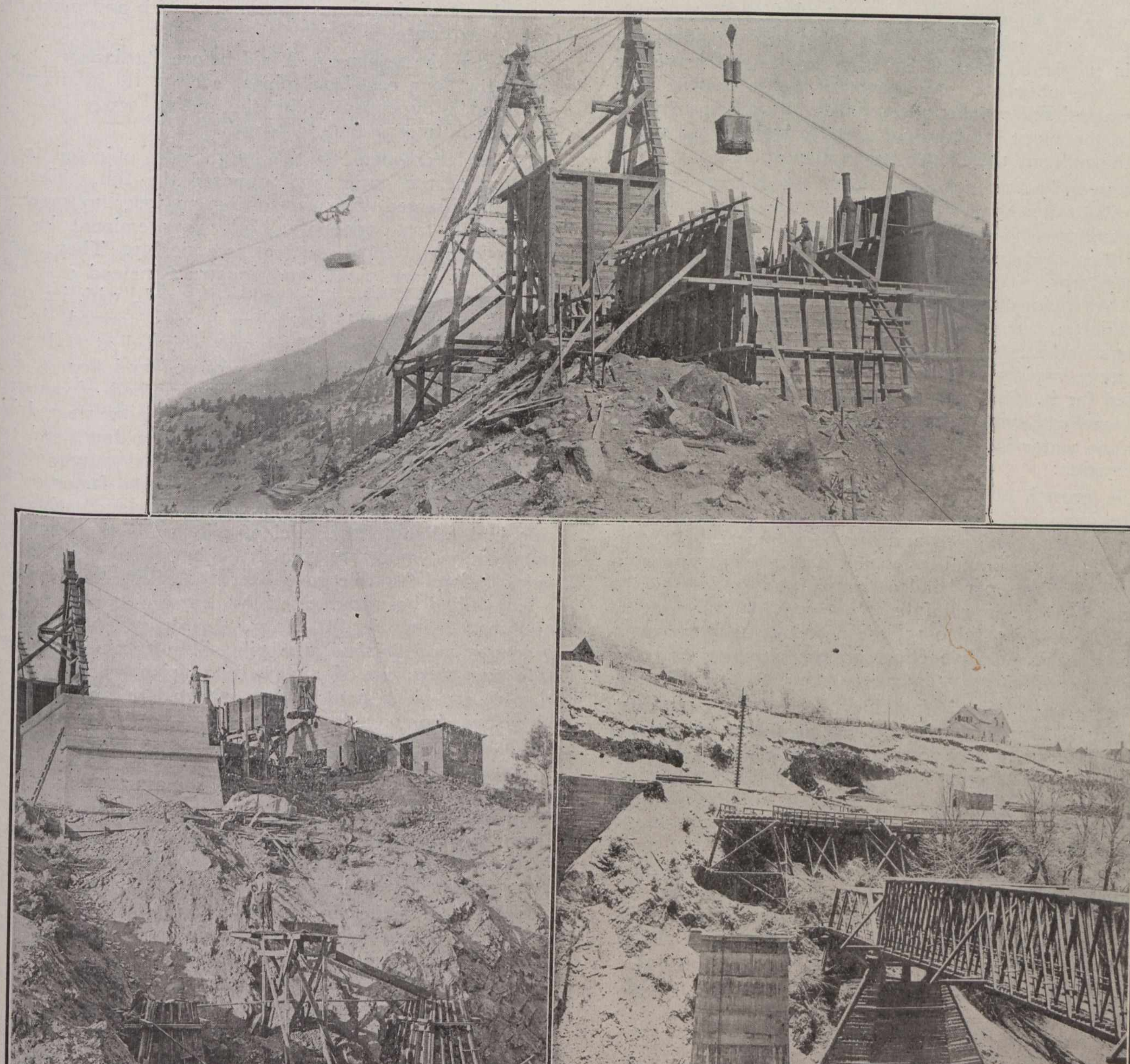


Fig. 5.—North Abutment in Place, Cableway and Bucket. North Abutment Completed and Pedestals of Steel Bent. South Pier and Timber Trestle Approach.

bent constructed, as shown in the second section of the same figure. The timber trestle approach on the south-eastern shore, shown in the distance in the third section, was completed early owing to the fact that the contractors were obliged to wait for lower water before commencing to build the main piers; and by January 19,1914, the south pier had reached the stage of advancement also indicated in the last section of Fig. 5. The photographs extending from each shore and carrying a Howe truss in the centre; and the latter, descriptive of the erection of the steel superstructure, all of this being placed by means of a cableway. The structure was completed finally and opened for traffic in June, 1914.

Reference was made to the design of this bridge in *The Canadian Engineer* for July 17th, 1913.

OUTFALL SEWER CONSTRUCTION.*

By James Munce, M. Inst. C.E.,
Deputy City Surveyor, Belfast, Ireland.

IN order to purify (where necessary) and dispose of sewage it must first be collected. The object of this paper is to ask engineers to take into consideration this particular section of their work, and leave for a little the chemists and bacteriologists to deal with the sewage itself which the engineers have collected for them in the place most convenient for getting rid of it, or of the effluent they leave us to dispose of.

As every portion of the country which is not a lake or marsh drains by gravitation to the sea, there is not except under very exceptional circumstances, any great genius displayed in designing a scheme entirely depending on pumps.

A town does not of necessity remove the natural watercourses, but there is no doubt the extension of buildings and streets with impervious surfaces sends the water more rapidly into the outlets, natural or artificial, provided for it. In fixing the sizes of sewers the sewage is the smallest item to be provided for, and the rainfall or surface water is the volume which needs most careful consideration.

The growth of the area within a reasonable period, and the increased use of water as the population increases, both in opulence and numbers, must not be forgotten. Many communities which a few years ago considered 25 gallons per head an ample supply now use 50 gallons. As sudden rainfalls often multiply the volume to be dealt with by 12 to 15, the positions of storm overflows and their possible effect on the streams or other outlets into which they discharge require careful study.

The problem in Belfast has been one of extreme difficulty. A large area of the city has been reclaimed from the sea, and many acres are so far below high-water level that they are only kept from daily flooding by the quay walls, which are 0.6 ft. above the highest recorded tide and 4 ft. above ordinary high water. Formerly the sewers all discharged into the harbor or into rivers which in turn discharge into it; they were protected by valves, and only discharged on the last half of the ebb tide. These have now been intercepted, and the area drained by them, and also the whole of the County Down portion of the city, 5,400 acres, form the low-level drainage area. It will be seen that as no storm overflows are available from the lower portion of this area except at and near the time of low water, storm pumps to relieve the sewers are unavoidable. The intercepting sewers extend for about 3 miles on the County Antrim side of the river, and rather more on County Down side, through lands and streets made on the reclaimed areas; they have a fall of at least 2 ft. per mile, and on the portions nearest the river are almost entirely through alluvial deposits known locally as "sleetch," or in-filling of all kinds deposited inside the reclamation embankment.

The difficulty of construction in ordinary filling was of the usual kind met with in such material, and is not further referred to. The sleetch is a remarkable material; when dry it crumbles like fine sand; with a little moisture it swells and becomes like a soapy clay; with a quantity of water it has the consistency of soft dough.

The main outlet sewer was constructed for a mile in slob lands of sleetch, which are dry at low water, but covered from 2 ft. to 6 ft. at high water. As an example of the unstable nature of this sleetch, it may be mentioned that when the author was making the surveys for the scheme in 1886 he put a man out of a boat on the apparently firm bank of a channel to fix a pole; he sank so quickly in it that he was rescued with difficulty, yet when the work was being carried out this same bank proved one of the firmest places met with and most difficult to excavate.

When the scheme was laid before Parliament it provided for four cast-iron pipes, each 4 ft. in diameter, surrounded by concrete, as the outfall sewer into the sea, one-fifth of a mile in length.

The landowners on the lough side objected to the position of the outlet and opposed the Bill. The corporation directed their consulting engineer to meet the adviser of the opponents, both very eminent in their profession, and settle the matter amicably. They agreed to omit the iron pipes, and construct instead a wooden double trough 1 mile long under the slob, with its outlet in deep water. This chute, as it was termed, is constructed of pitch-pine, which was shipped at Galveston, already cut to the scantlings required and floated from the vessel direct to the work. The method of construction was as follows: Two rows of sheet piles were driven of a length sufficient to form a half-tide dam, and constituted the permanent outer sides. The range of tide is 8 ft. in Belfast. When a length of 100 ft. or so had been driven, a cross-dam was formed, and when the tide had fallen to the level of pile heads the dam was pumped out and the excavators had about six hours' work before the tide rose over the piles again. When a length had been excavated the centre piles were driven, and the construction of the woodwork completed. When a length was finished, the pile sides forming the half-tide dam were cut off and were sufficiently long to form the centre piles for another length. In due time the chute was completed. During the past twenty-five years it has cost a great deal to repair. Many remedies were proposed for it. Hundreds of tons of old concrete were placed on its top, and strong piles fixed to keep it in its place. It is still there, but is unsatisfactory. A ferro-concrete outlet sewer is now being constructed alongside it; when this has been completed the old wooden one will be abandoned.

Lessons to be drawn from the experience gained are that compromises made between rival consulting engineers in the short time available during the progress of a Bill before a Parliamentary Committee are not always satisfactory, and that the considered design of an engineer who knows local conditions should not lightly be set aside.

This new outlet sewer through the slob lands will be in progress for more than another year, and is well worth a visit by any who can afford the time.

The present city surveyor carried out the repairs to the 5,500,000 gallons storage tanks constructed on the slob in a very ingenious way. These tanks were leaking and cracked in the bottom and sides; to rebuild them would have probably cost £40,000, besides the terrible upset to the whole outfall of the sewers. He took one tank at a time and forced cement grout into the crevices and under the floor; altogether 1,120 tons of cement were used. It was mixed with an equal quantity of sand, and was put in under air pressure varying from 7 lbs. to 15 lbs. per square inch. The reservoir is now quite watertight.

Excavations recently made alongside it show that the grout found all the crevices in the foundation and followed them through the sleetch, even 4 ft. beyond the outer walls.

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* From a paper read before the Blackpool (Eng.) Congress of the Royal Sanitary Institute.

The outfall sewer from junction of the high-level and low-level sewers at No. 1 pumping station to the outfall works is laid along the centre of an embankment about 150 ft. wide, formed of dredgings and sleetch lifted from the harbor during the previous twenty years. There is a timber pond on each side. When the sewer was commenced this embankment was comparatively dry, and the trench stood without timbering; those in charge were charmed, and for a week or two boasted of how cheaply the work was being constructed. Alas for their hopes! A few wet days changed all this, and sheet piling had to be adopted and left in for the entire length of the work to keep the sewer in line. Notwithstanding this precaution the arch cracked from end to end, and had to be made good before the sewer could be used. Some portions of it have spread, and had to be replaced recently. A road 50 ft. wide is now made along the embankment, and forms the approach to the outfall works.

As a relief to the main outfall sewer, and to make it available in times of storm for the increased volume flowing from the high-level area by gravitation, it was arranged to lay a 4-ft. diameter pumping main direct from No. 1 pumping station to the outfall works, a distance of about 1,000 yds.

Before deciding on the use of steel pipes careful examination was made of similar pipes which had been in use for some time as a sludge main from the tanks to the jetty where the steamer is loaded, and also of some others carrying the main outfall sewer under a sea channel; these proved to be in such good condition that the city surveyor had no hesitation in adopting similar pipes for this main.

They are 4-ft. diameter welded-steel pipes, 3/8 in. thick, with spigot and faucet joints. The material is in accordance with the British Standard Specification, and has a tensile strength of not less than 24 tons nor more than 30 tons per square inch, with an elongation of not less than 22 per cent. on a test bar 6 in. long. The pipes were raised to a temperature of 300 deg. to 350 deg. Fahr., and then dipped in a bath of Dr. Angus Smith's bituminous compound kept at a temperature 300 deg. Fahr. during the operation, after which they were covered with a wrapping of asphalted jute. They were then weighed, and the weight painted in white lead on the inside of the socket. When laid, the joints were caulked with gasken and 2½ in. of lead wool.

One decided advantage in the use of these pipes is the smaller number of joints to be made in bad ground, and the reduction of the volume of underground water which can enter such a pipe.

The amount of subsoil water which finds its way into trunk sewers, notwithstanding all attempts to make them impervious, is very large. Careful investigation in Boston proved that in pipes from 8-in to 36-in. diameter at least 40,000 gallons per mile per day got into the sewer, and it is estimated that on the average of large trunk sewers, 75,000 gallons per mile per day had to be provided for. These figures have, I believe, been adopted in the reports of the New York Sewage Commission. In waterlogged ground the figures would doubtless be greater.

On the other side of the harbor the subsoil is of an entirely different nature; sand is found in the lower portions, and red clay a little higher up. In the sand the tide rises and falls, evidently following some of the old channels of prehistoric days.

Some years ago, when a 5-ft. diameter sewer was being laid in a street 60 ft. wide, the trench was close-sheeted, and every precaution taken, as the contractor thought, to exclude water; yet he found it almost impossible to keep the trench dry enough to get in the concrete foundation, and claimed 50s. a lineal yard for an extra 6-in depth of excavation and concrete. (He was allowed 9s.)

An examination of an old survey of 1791, which lately came into the author's possession, shows that the site was at that date under the sea, and from other sources it is now discovered that the site was reclaimed about 1833.

Extensions of this sewer several miles in length were made through good ground, but one branch (about 1 mile), along what at one time was the margin of the lough, was nearly all the way through running sand. The contractor, however, put on very powerful pumps, and was able to keep the water out of the trench a sufficient time to enable the lower part to be built. Cracks appeared in buildings about ½ mile from the site; fortunately for him, his pumping operations were not suspected.

A relief sewer parallel to the main one referred to is now being constructed about 300 yds nearer the sea; although the ground is not good much of it being in-filling the difficulty of construction is much less than in the case of the original sewer.

LOST PRESSURE IN GASEOUS EXPLOSIONS.

The following item has been abstracted from a paper read before the British Association for the Advancement of Science by Professor W. M. Thornton, D.Sc.,D., Eng:

When the maximum pressure of an explosion is calculated from the heat of combustion of the elements of the gaseous mixture, values are obtained which are in all cases about twice those found by experiment. The mean of a large number of "efficiencies of explosion" for different combustible gases approaches one-half. To account for this, four chief suggestions have been made: (1) That there is dissociation of the products of combustion; (2) that the specific heats are much higher at explosion temperatures; (3) that the products are rapidly cooled by radiation to the walls of the vessel; (4) that the combustion is not complete at the time of reaching the maximum pressure. None of these is in itself sufficient to account for all the loss of pressure. The suggestion is now made that it may be caused by the forces of cohesion which come suddenly into play at the moment of formation of a molecule, check the translational energy to which alone pressure and temperature are due, and raise for the moment the rotational energy of the combining bodies. It is shown that the ratio of the translational energy of two colliding and cohering bodies before and after collision is one-half, and this ratio is to be expected for the whole mixture.

The suggestion receives support from the form of the curve connecting efficiency of explosion and changed percentage of gas in the mixture. This efficiency can be shown to have the form $\mu = 1 - B N$, where B is a constant and N is the number of combustible units in unit volume. A combustible unit is defined as that group of one molecule of combustible gas and of oxygen atoms just sufficient for its complete combustion. At the upper limit N is zero, and the efficiency curve is triangular on a base coinciding with the limits of inflammability. Its mean height is therefore one-half of the maximum, and this agrees very fairly well with the observed values given by Clerk in the case of coal gas.

REFUSE DESTRUCTION.

By R. O. Wynne-Roberts,
Consulting Engineer, Regina, Sask.

[NOTE.—This very interesting paper was prepared by the author for presentation at the Convention of the Canadian Public Health Association, to have been held in Fort William two weeks ago, but which was cancelled owing to the European strife.—EDITOR].

ONE of the primary duties of a municipal authority is to dispose of the waste products of a city, quickly, hygienically and economically. Such duty, however, is a somewhat difficult one to carry out, sometimes. The satisfactory disposal of sewage, for example, has engaged the attention of specialists for many years, and it must be acknowledged that in a great number of places the efforts to efficiently treat sewage have more or less been failures, for a satisfactory effluent is to be found in only a few places. Yet, a solution must and will be found for this problem, and meanwhile communities are perforce to adopt the best available process.

In the matter of refuse disposal, the situation is somewhat dissimilar, for a large number of towns have surmounted the difficulties with good results.

The temptation is to dispose of the refuse by the easiest, even if it is not the most sanitary, means. Refuse tips are plentiful, but the modern tendency is to abolish such dumping grounds as are used without discrimination, and adopt some other method. It is somewhat late in the day of advanced sanitation for filth to be deposited on the outskirts of a city without care or consideration and thereby be an annoyance to the people who are dwelling in the neighborhood, if not create a menace to the public health.

Town refuse consists of such a heterogeneous mixture, it varies in every load, every day and in every place. In cooler climes there is a larger proportion of ashes, whilst in warmer latitudes vegetables and other refuse will be more pronounced. Refuse from towns in districts of high rainfall and humidity will probably be more moist and resistent to fire than in districts of low rainfall and humidity, in spite of the receptacles being usually covered.

The quantity of refuse produced per capita in Europe is less than in America and as a rule no division is made for the purpose of collection.

In America, town refuse is often divided into three main classes: garbage, which "consists of organic waste or residue of animal, fruit or vegetable matter, and any matter or substance used in the preparation, cooking, dealing or storage of meat, fowls, fruit or vegetables"; ashes, which "constitute waste due to the combustion of coal or other combustible material, from residences, manufactories or business places and consists of fine ash, clinker and unburned coal"; rubbish, which consists of discarded and useless waste matters from residences or places of business not classified as garbage or ashes, such as paper, straw, excelsior, rags, bottles, old clothes, shoes, tin cans and other like waste materials."[1] There are other refuse such as manure, street sweepings, dead animals, night soil, sludge, etc.

In America, the collection of town refuse is often made separately for each class named. Separate receptacles have to be provided and the contractors or the municipal authority make periodical calls to remove each class of refuse. Much depends upon the frequency of such collections, as to the cost of the work and the efficacy of this system. Daily removal by municipal forces will obviate practically all nuisance, and if rightly organized a combined collection can be as economically done, if not more so, than insisting on the wrapping of garbage in paper and the separate collection at less frequent intervals. It can be easily understood that the separation of garbage, ashes and rubbish entails the loyal support of the householders and the ordinary experience is that the simpler the duties imposed upon the householders and others, the more likely they are to be performed.

The common method of refuse disposal is by dumping it into depressions or pits or on waste land. Reference has already been made to this and it is therefore necessary only to state that progressive authorities are becoming more insistent that such a method is not desirable in well-governed cities, unless due care is taken to cover the refuse with earth or other deodorant.

The disposal of garbage on pig farms is repugnant to the minds of all citizens having a high regard for the welfare of the people, and for the production of food by clean methods. It is stated that about 75 pigs are necessary to dispose of one ton of garbage daily.[2]

In Los Angeles, Cal., the garbage piggery was investigated by the Grand Jury. They reported that "the investigation of this Grand Jury shows that at the present time (March, 1912) there are located on the hog-ranch about 21,000 head of hogs; that the percentage of death of the hogs ranges from 40 to 65. We find, further, that the percentage of tubercular hogs on this ranch ranges from 10 to 20. Of this number two per cent. are condemned by the health officials, the other portion being placed on the market. We further find that cholera, strike, swine plague or swine fever is prevalent at the ranch at all times. In fact we find that at the present time this hog-ranch is quarantined for all purposes except for the purpose of slaughtering for food."[2]

It is palpably unnecessary to add to the foregoing indictment. The writer is unaware if this practice prevails in Canada.

It may be stated that a contractor has recently been awarded the contract for the disposal of the garbage of Los Angeles by means of a garbage reduction plant. The city is to receive 51 cents per ton for the garbage.[3]

Two cities in the United States own garbage reduction plants, namely, Columbus and Cleveland, Ohio. There are other cities where contractors have erected reduction plants to deal with the garbage of these cities.

This method was first introduced in Germany (where, curiously, it is not much used to-day) and later on it was introduced into the United States. It is similar to the plants installed in packing houses to dispose of the offal and to convert it into saleable by-products. Some of the reduction plants are operated on the "drying method," but the "cooking method" is stated to be the most satisfactory. The process consists of placing the garbage in steel digestor tanks, and when about 10 tons are so disposed of, the valves are closed and steam is admitted. After a few hours' cooking, the mixture is pressed to extract the free grease and the moisture. The solid matter is then dried and afterwards saturated with naphtha, gasoline or other solvents to dissolve the remaining grease. The solvent is recovered by distillation and the grease and tankage is sold to buyers, who refine the

[1] Report of the City Waste Commission of Chicago, 1914.

[2] Refuse Disposal in Small Cities and Towns, by Samuel A. Greeley, Illinois Society of Civil Engineers, 1913.

[3] Journal of Cleveland Engineering Society, March, 1914.

grease for various purposes, and the tankage is used for fertilizers.

Columbus is a city of about 185,000 inhabitants and the reduction plant has cost about $220,000. The sale of the grease and tankage brings more revenue than is sufficient to pay the cost of operation, plus the capital charges, as will be seel below:

Financial Statement for 1913.

1,095,594 lbs. of grease sold	$40,839.35
2,095 tons of tankage sold	14,223.31
Hides	1,247.39
Miscellaneous	489.73
Total receipts	$56,799.78
Total operating expenses	$39,560.25
Gross profit	$17,239.53
Allowing 4 per cent. interest and 20-year sinking fund	$16,292.00
Net profit	$ 947.53

The total quantity of garbage received was 20,710.74 tons, so the net profit amounted to about 4.57 cents per ton.

Garbage, however, is only one portion of town refuse and incidentally it may be mentioned that the householders in this large city, have to dispose of their refuse, other than garbage, by arranging with any one of the 140 private contractors.[4]

Columbus is now installing a Sterling destructor to cremate rubbish only. Natural gas is available and consequently the proportion of ashes is stated to be small.

Garbage reduction plants are capable of being operated with profit in cities of over 100,000 inhabitants. Mr. C. O. Bartlett, however, expresses the opinion that any small place producing one ton of garbage per day can be successfully treated in this manner.[3]

A full description of the reduction plant erected at Boston for the Boston Development and Sanitary Company, is to be found in the "Engineering Record" of May 10th, 1913, and of the Columbus plant in Mr. Irwin S. Osborn's report of January 1st, 1913, to which those interested in this process are referred for further particulars.

A number of towns in Britain have adopted the Lightning Dust Manipulator, for instance, Southwark, a large borough in London, Halfax, Hove and others. The process consists in pulverizing the raw refuse into manure. This is done by means of high-speed revolving hammers striking the refuse against the breaking block and a final disintegration effected by trituration between the hammers and the grinding plate. Southwark sells about 20,000 tons of manure annually. The manure is similar to black mold, and as the Southwark works are located in a populous part of London, and the plant has recently been extended, the process is practically inoffensive. Hove is one of the fashionable seaside resorts in South England and Halifax is a large commercial centre in Yorkshire.

The text of this paper is Refuse Destruction, and the remainder of the writer's observation will be confined to it.

For the sake of a clearer definition, furnaces operated at a temperature of about 1,500 degrees Fahr. or less, will be called incinerators, and those which have a working temperature of over 1,500 degrees will be called destructors. In America these furnaces are called low and high temperature incinerators respectively. It seems preferable to know what is referred to by a distinctive name, rather than by a qualifying term which is often omitted.

Fire is the oldest and best-known method of disposing of offensive rubbish. It has been adopted by all races and in all ages, with more or less satisfaction. Burying offensive matter is another ancient and effective way of getting rid of such matter.

The first engineer who successfully designed a furnace to effectually destroy town refuse by fire was Mr. Alfred Fryer, of Nottingham, England. This was in 1874. He built two such furnaces in Manchester in 1876 and these have been extended and improved and are still in use, which fact at least suggests that Fryer had evolved a scheme based on right principles.

This innovation, however, met with a hostile reception. The public prejudices against the adoption of such furnaces were so strong that it is surprising it survived.

Following Fryer, there were several aspirants who claimed to have designed furnaces superior to Fryer's, for example, Pickard's "Gommand," Wilkinson, of Birmingham; Healy, of Brighouse; Heard, of Paddington; Burton, of London; Stafford and Pearson, and others, but Fryer's furnace held its position. These, and some which were designed later on, were of the incinerator class—low temperature, slow burning, producing soft clinker and obnoxious gases. Mr. Charles Jones (Ealing) in 1885 introduced his "fume cremator" which was an ample proof that something was needed to improve the combustion.

Mr. William Horsfall, in 1887, brought out the first high temperature furnace, which improvement gave a new impetus to the process. Horsfall also improved the furnace by arranging for a front exhaust of gases, by which means all gases had to pass over the active grate before being discharged and by so doing the fume cremator was found to be unnecessary and was ultimately abandoned.

From 1887 to the present time many improvements have been introduced, such as steam jet blowers, forced air draft, regenerators or air pre-heaters, continuous grates, twin grates, mechanical feeders and clinkering, dust catchers, steam producers, and so on. To deal with each of these would entail a long paper, as each maker has devised certain features in connection with furnaces, etc. They will, therefore, be referred to collectively as far as possible.

Incinerators, then, are the survivors of the earliest types and destructors are the later developments.

Incinerators are furnaces capable only of slow combustion and require some form of drying-hearth or device for reducing the moisture contained in the refuse, preparatory to creation. Some incinerators are charged with large quantities of refuse at one operation, the result being the lowering of the temperature of the furnace, the prolonging of the period of cremation as the combustion is more often local than general, the passage of green gases and the production of soft clinker and little steam. An analyses of the gases and a record of the maximum and minimum temperatures in incinerators will doubtless show that the work done is not altogether satisfactory.

Experience has shown that with destructors the same as with other furnaces, the percentage of carbon dioxide, oxygen and carbon monoxide contained in the gases in the main flues, is in proportion to the completeness of the combustion of the fuel and the carefulness of firing and clinkering.

It is manifest that not even the best coal-fired furnace can produce satisfactory percentages of the above con-

[4] Report on Disposal of Refuse, Newark, N.J., 1912.

stituent gases of combustion unless the temperature of the furnace is uniformly maintained, the range of heat fluctuations kept as small as possible, the quantity of primary and secondary air supplied is controlled to satisfy as nearly as practicable the requirements of the fuel used, and that the fuel is charged in small and regular quantities. Although coal is not usually quite constant in its calorific quality, it is vastly more so than town refuse, and if care is needed in the case of coal-fired furnaces, it is reasonable to advocate somewhat similar care in the cremation of refuse, if scientific and sanitary results are to be achieved.

Many incinerators require coal or other fuel to assist in the combustion of refuse, although the proportion of combustible matter in such refuse approximates that contained in refuse in other places where, with destructors, no other fuel is required or used, and good clinker and power are produced.

Engineers have during the last century developed the design of coal furnaces for steam raising and countless other purposes. Different grades of coal require different types of grates, etc. It would not be expected that a grate designed to burn steam coal with the maximum of efficiency would produce good results if bark was consumed.

A prudent manufacturer who requires a furnace for any ordinary industrial purpose would ordinarily adopt one that has already proven efficient, and if for any special purpose which needed some experimentation, he would start where others had left off, (unless he had good reasons for doing otherwise) and so make use of whatever knowledge that was available.

Bearing in mind what has been achieved in many parts of the world with destructors, it would seem inadvisable to erect incinerators.

The more municipal engineers investigate this important problem, the more readily they will appreciate the necessity for the fullest consideration of the capabilities of various types of furnaces which it is contemplated to install.

There are several makers of destructors and incinerators on the market, and the writer does not propose to exploit any particular one. Each maker claims to have some features of superiority over others and doubtless some do possess certain advantageous qualities.

The original furnaces were top-fed and some are now being built on this plan, but in course of the last ten years or so back feed and front feed arrangements are found to answer rather better. Top feeding allows of mechanical labor-saving devices being used, but even then it entails more arduous labor to the men below in raking in the material by long rakes over the fires. Back feeding was introduced in 1891 and is claimed to be under better control, whilst front feeding means a better concentration of labor. Conditions will vary in different places and these must be taken into account when deciding the method of feeding.

Destructor furnaces require a strong draft in addition to the normal pull of the chimney, although, as one writer stated, since it has been demonstrated that incandescence can be maintained apart from the use of fans and regenerators, the question to be considered is whether it is good practice to run machines which absorb up to 15 per cent. of the total steam produced.[5] The steam jet is a simple, effective and economical blower, and the fan, being entirely mechanical, is more subject to wear and tear and liable to breakdowns and therefore should be in duplicate. The furnace pressure should be in balance, that is, the force of the blast under the furnace should be slightly in excess of the draw of the chimney, so as to render the intake of air at the doors during the time charging or clinkering takes place, as nearly nil as possible. The aim, nevertheless, of the furnacemen is to have these doors opened as few times as possible.

[5] Surveyor, January 31st, 1913.

The advantage of either forms of blast does not appear to be very pronounced and to provide for all contingencies, the makers now usually include both in recent installations.

Pre-heating of the primary air is claimed to be of considerable value. The air, after being pre-heated, absorbs the moisture in the refuse most readily, and this is found to be done sufficiently quickly that refuse can be cremated without the intervention of a drying hearth. In ordinary steam boiler practice, pre-heated air is found to be of much value, for it increases the amount of water evaporated per hour. Brislee[6] gives an example of the advantage of pre-heated air. Two boilers were tested with the following results:

	Number one boiler. Cold air.	Hot air.
Weight of water evaporated, in pounds of water per hour	22,910	40,966
	Number two boiler. Cold air.	**Hot air.**
Weight of water evaporated, in pounds of water per hour	15,800	24,600

The increased evaporation was due to the extra heat brought into the furnace and the increased rate of combustion of fuel due to it.

In the case of the boiler No. 1 the evaporation was increased 79 per cent. and the No. 2 55.4 per cent.

Brislee points out that if air is heated before combustion is allowed to take place, then the heat in the air is added to the heat of combustion, and the quantity of heat available for raising the temperature of the products is therefore greater. In other words, conditions being equal in other respects, the pre-heating of air means economy of coal and the increased output of the boiler.

In destructors, however, regenerators do not constitute the only method of pre-heating of air. Regenerators consist of stacks of pipes, through which the hot gases pass out on their way to the chimney and around which the cold air passes into the furnaces. The sensible heat of the hot gases is partially imparted to the cold air and in this way the temperature of the air is increased from 200 to 300 degrees, or often more. This, of course, means the conservation of heat which would otherwise be lost in the chimney. Such regenerators offer some obstruction to the outgoing gases and to the incoming air, and to overcome this it is necessary to absorb some energy in driving fans. About 5 to 10 per cent. of the total steam produced from the refuse is thus utilized. Regenerators have in some instances been taken out for different reasons. It is easy to arrange for the primary air to be heated by passing it through flues built in the walls of the furnaces. This is being done in gasworks practice and has been found to be very effective. Indeed, such method of pre-heating air or an adaptation of the idea is provided in some destructors. Incidentally, the air required for the furnaces is taken from the vicinity of the refuse and by this means the building is ventilated.

[6] Brislee. Introduction to Study of Fuel, 1912.

Continuous grates in one chamber are supplanting individual cells and grates and the advantage is evident. In the case of individual or single cells when refuse is charged into the furnace it has the tendency of lowering the temperature of that cell, and the effectual mixture and burning of the gases must take place in the combustion chamber. Whereas, in the case of the continuous grates, two or more grates are built side by side in one chamber with independent ash-pits beneath. When any refuse is charged onto any one of these grates, the cooled gases therefrom are mingled and burned in the furnace itself and no gree gases can escape into the combustion chamber without first passing over an incandescent body. Meldrum's Simplex Destructor was the first constructed on this principle and its usefulness was appreciated by other makers. Heenan and Froude, Horsfall, Fryer, Dawson and Manfield and other destructor builders now design some form of continuous, twin or series grates.

Mechanical stoking and clinkering and other forms of labor-saving devices are installed in a number of destructors. Boulnois and Brodie's charging trucks, Marten's charging apparatus, Horsfall's tub feed, Heenan and Froude's hydraulic feeder and others are examples of the methods most in use. Heenan and Froude's trough grate and hydraulic ram clinkering machine and Sterling's clinkering grate are installed in many plants. According to Mr. Fetherston's report[7] the arduous work of charging and clinkering at the Clifton (New York) destructor has been reduced by the use of the hydraulic ram charger and clinkerer and trough grate. The following figures are extracted from his report:

Comparison of Work Elements.—Official Tests.

Plant. Both in New York.	Cost per ton supervision and labor.	Pounds burned per furnace man per hour.	Pounds burned per sq. ft. per hour.	Per cent. of time furnace door open.
West New Brighton, 1908	$0.76	1,357	54.3	73.7
Clifton, 1913	0.41	3,330	144.2	5.1

Mr. Fetherston, however, expresses his opinion that some time must elapse before the complete economy of the mechanical devices is demonstrated.

Conveyors have been tried in several installations, but owing to the heterogeneous character of the refuse, they have not always been found to answer. The same remark applies to refuse elevators, etc. The three buckets and rake elevators in use at the Hackney destructor (London, England) capable of raising 10 to 12 tons per hour, are found to be very expensive to maintain and are liable to serious breakdowns.[8]

Hoppers or storage bins above the destructor furnaces are often found to be unsatisfactory, owing to the tendency of the refuse to bind and arch over the opening, and the bulky nature of the refuse often renders the hoppers inadequate in capacity, in which case some city authorities store the refuse in the carts or wagons and thus obviate creating of nuisance. In some cases the refuse in bins tends to ignite and cause an emission of noxious gases. In recently built destructors the hoppers are located behind or in front of the furnaces and are sufficiently large to hold one or more day's supply. Such a position is both cool and handy for hand-firing.

In the more recent developments of destructors the authorities have observed that it was possible to derive considerable steam power. The ordinary steam-producing capacity of destructors is calculated at one pound of steam for each pound of refuse burned, and as one horse-power may be based on 30 pounds of steam per hour, it will be seen that one ton (2,000 pounds) will, on the above basis, produce 67 horse-power, but a large quantity of steam is required for the plant itself, so that the net quantity of steam available for other purposes is less.

There are plenty of instances where the production of steam has exceeded one pound per pound of refuse.

Official tests made at the Clifton destructor in 1913 with a winter mixture of refuse gave a gross equivalent evaporation from and at 212 deg. Fahr. of 1.00 to 1.11 pounds at a pressure ranging from 117 to 126 lbs. per square inch, but at the West New Brighton destructor the results were 1.10 to 1.41 pounds of steam at a pressure of 130 to 137 lbs. per square inch. The production of steam during the year 1911 was 1.23 pounds per pound of refuse.[7]

In Milwaukee, the evaporation was 1.34 to 1.45 pounds and at Westmount, P.Q., from 1.48 to 2.11 pounds.[4] In Calgary, Alta., the average evaporation at tests was 1.13 pounds. In Darwen (England) the average evaporation during the year was 1.23 pounds, whilst on a test when burning unscreened refuse and slaughter-house refuse was 1.55 pounds of steam from and at 212 deg. Fahr. In Huddersfield (England) with one part of sewage sludge and two parts of refuse 1.4 pounds of steam were obtained.

A test was made in Rochdale (England) for the purpose of comparison. By using ordinary coal slack having a calorific value of about 12,500 B.t.u. 7.33 pounds of steam were produced from and at 212 deg. Fahr., as compared with 1.97 pounds from refuse.[9]

At Montgomery (Ala.) in 1911 the following test results were secured: 1.37 pounds of steam per pound of refuse; carbon dioxide in the waste gases, 11 per cent.; temperature in combustion chamber, 1,920 deg. Fahr. The refuse consisted of 25 per cent. ashes, 42 per cent. garbage, 13 per cent. rubbish, and 20 per cent. manure.

The steam produced by burning refuse is utilized for a variety of purposes, such as pumping sewage, or water, generating electricity, etc.

Part of the steam generated from refuse in London, Ont., is used for heating the Victoria Hospital, which is situated fifty feet away. In one city 72 million foot-pounds of energy is derived from every ton of refuse and used for pumping sewage. In Liverpool and Rotterdam, for example, the electric energy generated is used for street railway operation. In West New Brighton and Clifton plants, already referred to, a large quantity of steam is not utilized owing to the fact that the New York City charter prohibits its sale and consequently no revenue can be derived in this manner. This represents a loss of about $7,500 per annum. The quantity of refuse burned at each of these places is about 9,500 tons per year. In Westmount, P.Q., the destructor is an auxiliary enterprise operated in the same building as the municipal electric lighting plant, the steam generated by the cremation of the refuse being used in the production of electrical energy. Messrs. Hallock and Runyon, the engineers who were appointed to report on the disposal of refuse by the City of Newark,[4] stated that the total revenue in 1910 for electric lighting and destructor plants was $102,149.17, and the total cost of operation of the combined plant was $75,426.38, leaving a net profit of $26,722.79. The operating costs include all capital

[7] J. T. Fetherston, New York, February, 1914.
[8] Journal of Institution of Municipal and County Engineers, July, 1914.

[9] Refuse Disposal and Power Production, Goodrich.

charges and depreciation. The cost to the Health Department for the refuse destroyed was $9,449.06 for the year. The population of Westmount is about 16,000.

Other examples could be cited but the paper is already longer than was anticipated.

One incidental result of good steam production is the production of good clinker, which can be used for many purposes. Low temperature cremation results in soft clinker which is not only useless but objectionable, as it cannot be used and it often contains partially consumed organic matter. Clinker should be well fused and vitrified and this can only be produced by maintaining an uniformly high temperature in the furnace.

Good clinker is used for making pavement slabs, for sewage filtering media, brickmaking, crushed into sand and mixed with lime for mortar, etc.

Reference has already been made to steam production. In the earlier plants, the boilers were placed in the furnace directly over the fire, but it was found that the cooling effects of such boiler militated against the successful cremation of the refuse. The next step was to place the boiler between two cells and, although better results were obtained, the makers in later installations have located the boilers beyond the combustion chamber. By this means the maximum temperature is secured and the gases adequately combusted before coming into contact with any cooling surfaces. The figures quoted point to the possibility of developing considerable power by the high temperature cremation of refuse. If due attention is paid to the fundamental requisites of a destructor the cost of operating the same can be materially reduced by the sale or utilization of the steam and hard vitrified clinker produced.

In conclusion, the author has observed that some disappointment has, in places, been experienced owing to the makers' claims being exaggerated and impossible of realization. It would, of course, be folly to decry every new device, arrangement or design, until it has been put to a practical test, for that would be tantamount to placing an embargo on all legitimate developments, but experiments are costly and occasionally disturbing, as was recently found to be the case in a large plant in North America, whose designers received due publicity in engineering journals. The achievements that were going to be accomplished fell short and the works are now being improved.

The evolution of the destructor has been slow and expensive and the results of experience in all parts of the world has greatly assisted the makers in deciding upon the arrangements, capacity and construction best suited for the refuse produced in different places in different climes.

New York, Westmount or other destructors in the east may not be quite suitable for western refuse, and doubtless this is the case. Each city has its own problem to solve and it, therefore, behooves that the authority contemplating the installation of a destructor or incinerator should take the fullest possible advantage of the experience of others under similar conditions and of the plant best suited to satisfy its own specific needs.

A Government wireless station will shortly be opened on Valentia Island, on the southwest coast of Ireland. It has been constructed by the wireless department of the Post Office, the installation being supplied by the Marconi Company. With a range of 500 miles, it is chiefly destined to keep Atlantic liners in touch with land two hours longer than is possible at present with the Crookhaven station.

THIRTY-THIRD CONVENTION, AMERICAN ELECTRIC RAILWAY ASSOCIATION.

The program for the 33rd Annual Convention of the American Electric Railway Association to be held at Atlantic City October 12th to 16th has been announced. The American Association proper and its four allied associations—Engineering, Accountants, Claims, and Transportation and Traffic—all hold sessions during the time of the convention. The programs are very elaborate. Over 73 committees are to report and papers are to be read on some very important subjects. The speakers before the American Association include Hon. Frank W. Stevens, former Chairman of the New York Second District, Public Service Commission; H. C. Donecker, Assistant General Manager, Public Service Railway Company, Newark, N.J.; Calvert Townley, Chairman of the Board of Directors, Lackawanna and Wyoming Valley Rapid Transit Company; Harry A. Bullock, Secretary, New York Municipal Railway Corporation, and R. B. Steams, Vice-President, The Milwaukee Electric Railway and Light Company.

Among the important reports to be made is one from the Committee on Public Relations, presenting a "Platform of Principles" covering what the committee believes to be the fundamentals of a lasting and proper adjustment of relations between the railways and the public.

The Accountants' Association is to consider the new classification of accounts which was prepared by the Interstate Commerce Commission in connection with one of the committees of the association, and will pass on a plan for an educational course for the accounting employees of electric railways. John R. Wildman, Professor of Accounting, New York University, H. S. Swift, treasurer, West Penn. Traction Company, J. F. Fogarty, secretary, North American Company, A. T. Smith, assistant chief, Division of Valuation, Interstate Commerce Commission, and Robert Sealey, North American Company, will deliver addresses.

The Engineering Association has a very large number of important matters to come before it, including the reports of its standing committees.

To the Claims' Association will be presented the report of its committee having in charge the formation of an accident prevention board, which it is intended will conduct a campaign for the prevention of accidents among the electric railways of the country.

Among the speakers before the Transportation and Traffic Association is N. W. Bolen, General Superintendent, Public Service Railway Company, Newark, N.J., who will talk on the Organization of a Transportation Department. This association will consider among other things a report of the committee dealing with the question of motor buses as auxiliary for electric railways.

The report of the Joint Committee on the Joint Use of Poles, made up of representatives from the American Electric Railway Association, National Electric Light Association, the American Institute of Electrical Engineers and the American Telephone and Telegraph Company will be considered by the American Association.

This committee has now been at work for two years in the preparation of a form of agreement and specifications covering the joint use of poles and the adoption of its report, it is believed, will mean much in the clearing up of obstructions in the streets of the cities of the country.

GUTTER CONSTRUCTION FOR STREETS AND ROADS.*

By T. Hugh Boorman, C.E.

HIGHWAY engineers and road specialists have always agreed that the pre-requisite for a good pavement is proper drainage and a substantial foundation for the wearing surface, and it is now generally conceded that we must have a waterproof surfacing even for country roads.

On a building's roof, we must pay the greatest attention to the gutter and afford the best method possible for the carrying off of the rain water to the outlets as efficiently and speedily as possible. Given the fact that we are to roof our roads with waterproofing material, does it not follow that we should apply similar precautions for road roofs?

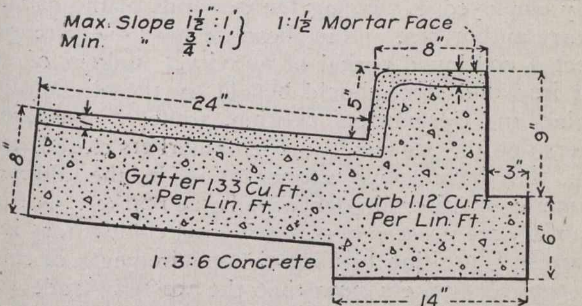

Fig. 1.—Standard Type of Combined Curb and Gutter.

In the June 10, 1914, issue of "Engineering and Contracting" is given the construction of concrete curb and gutter as adopted in Washington by the District Commissioners, under the supervision of Captain Mark Brooke, Engineer Corps, U.S.A.:

"**Concrete Curb and Gutter.**—In Fig. 1 is shown the standard type of combined curb and gutter in general use. It will be noted that the curb is unusually thick and the base therefor is quite broad. The method employed in laying is as follows:

"A trench is excavated and trimmed to a depth of at least 14 inches and a bed of bank gravel, free from excess clay or loam, spread to a depth of 6 inches and rammed. In making the curb, forms are placed and the mortar face formed by plastering on the inside before the curb concrete is laid. Curb and gutter is divided in 10-foot lengths, a clean cut joint being made either by use of a thin metal plate or with heavy paper. The face forms on the curb are removed within 24 hours and the surface troweled to a neat finish.

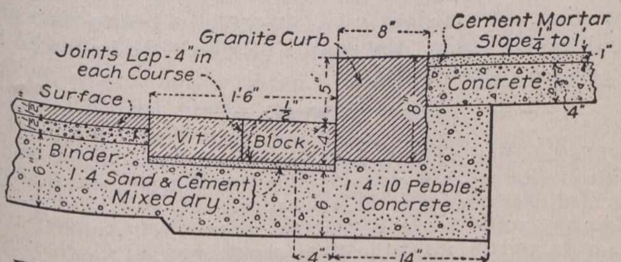

Fig. 2.—Granite Curb and Vitrified Brick Gutter.

"The specifications call for a high quality of sand and no stone over 2 inches in diameter. The mortar surface on gutters is placed immediately after laying concrete and thoroughly manipulated by troweling and beating with wooden battens so as to break any air cells and make the surfacing solid. Joints are filled with sand. A coating of dry cement and fine sand, 1:1 mix, containing thoroughly incorporated coloring matter, is floated on the surface. A jointing tool is used, cutting to a depth of ½ inch, and the exposed surface covered with sand for protection.

"**Granite Curb and Brick Gutters.**—The granite curb and vitrified block gutter is shown in Fig. 2. Granite curb is set in the following manner:

"A trench is excavated 18 inches wide and 15 inches below the top of the curb when set. One edge of this trench is 4 inches beyond the finished curb line toward the centre of the street. Five inches of 1:4:10 pebble concrete is placed in this trench and the curb set immediately, heavy mauls being used to bed it firmly. As soon as the curb is laid the trench on the sidewalk side is filled to within 5 inches of the top of the curb with concrete tamped in place. Excess concrete in front of the curb which will interfere with laying vitrified block gutters is removed and earth filled in behind the curb to prevent too rapid drying out of the concrete. No provision is made for longitudinal joints between the curb and the street surface base.

"In laying the gutter as soon as practicable after the concrete base has been laid, a dry mixture of sand and cement is spread to a thickness of not less than ½ inch as a bed for the paving blocks. The blocks are laid on edge joints, being broken so that each block has at least a 4-inch lap in every course. A plank is laid over several courses and a rammer used until the blocks reach a firm bed and present a uniform surface. After ramming, the gutter is grouted with a thin, easy flowing grout of neat cement."

On examination of the concrete gutter on the Chevy Chase experimental road sections in Washington and Maryland last month, I found several cracks, and venture the opinion that a prepared asphalt joint applied across the work every 25 feet would obviate this trouble at a very trifling expense. The work referred to, however, is in connection with broad avenues and streets having no business traffic; and what I wish to emphasize is the fact that in our city streets particularly our construction of gutters is generally poor, from the fact that stone blocks are used transversely, instead of longitudinally.

In England the gutters are laid longitudinally generally in the case of stone or wood blocks, with the inner two lines depressed about half an inch, so forming a natural curved gutter.

I have seen asphalt blocks on roads at Irvington, N.Y., so laid, and on the approaches to the North Philadelphia Depot of the Pennsylvania Railroad brick has been set in this way; on one side of the depot twelve courses of brick and on the other eight courses.

I contend that in all cases where other than a monolithic sheet pavement is used, the gutter should be paved with blocks, longitudinally laid, and with a natural curve. While realizing that innumerable varying surfaces, requiring different construction of gutters, call for exceptional work, I am submitting the following suggestions for consideration:

When practicable, all avenues and broad thoroughfares, other than in business sections, should have a Portland cement concrete curb and gutter, preferably strengthened and made more thoroughly waterproof by the addition of some of the improved dry or liquid compounds.

*From a paper read before the American Society of Engineers, Architects and Constructors, July 4, 1914.

For country and suburban roads, where cobblestones are obtainable, they should be laid from two to three feet in width, and after being placed should have poured in the interstices hot pure asphalt. Asphalt should be used which is of the best grade, free from coal tar or any of its products, and which will not volatilize more than one-half of one per cent. under a temperature of 300 degrees Fahrenheit for ten hours. The asphalt should not flow under 212 degrees Fahrenheit and should not brittle at 15 degrees below freezing, Fahrenheit, when spread thin on glass. In all cases of brick, stone, or wood blocks laid longitudinally along the line of curb and with joints broken, said joints should invariably be filled with asphalt cement of quality above described.

MUNICIPAL DEVELOPMENTS AT ASSINIBOIA, MANITOBA.

In *The Canadian Engineer* for September 3rd a description was given of the water and sewerage systems recently installed at Deer Lodge, in Assiniboia, a western suburb of Winnipeg. Since its publication we have been favored with some additional information respecting municipal improvements that have been made during the past several years in that locality. In this time over $410,000 have been expended in the municipality of Assiniboia for water supply and sewerage systems, and similar work to the extent of $500,000 is contemplated and in the process of design. During the past two years, also, pavement and bridge work has amounted to $215,000, construction work at the present time amounting to $170,000. Mr. G. W. Rogers is engineer for the municipality.

DECEMBER MEETING, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

At its annual meeting in New York December 1 to 4, the American Society of Mechanical Engineers will have a session on engineering metals and their application to methods of manufacture. Steels for construction and for tools, cast-irons and alloys of copper, tin and aluminum will be particularly investigated, with a view to bringing out as a matter of common knowledge the advances that have been made in these fields up to the present time. The session will be in charge of the sub-committee on iron and steel. A number of papers will be presented.

Another session that will be most interesting is that devoted to the general subject of engineering in connection with civic administration and public service. Papers on municipal engineering and related matters will be presented, among which are noted: "Utilization of Municipal Wastes," by Irwin S. Osborn, consulting engineer to the Department of Street Cleaning, Toronto, and other cities; "Training of Municipal Employees," by H. M. Waite, city manager, Dayton, Ohio; "The Cleaning of Filter Sands," by Sanford E. Thompson, consulting engineer, Newton Highlands, Mass.; "Controlling Factors in Municipal Engineering," by M. L. Cooke, director, Department of Public Works, Philadelphia, Pa.; "The Cleaning of Public Buildings," by W. H. Ball, Chief of the Bureau of City Property, Philadelphia, Pa.; "Municipal Colleges in Germany," by C. L. King, University of Pennsylvania, etc.

The usual sessions on machine shop press, railroads, etc., will be held. The above are mentioned in particular as being of special interest to our readers.

WAR AND ENGINEERING TRADE ABROAD.

The following interesting item on the effect of the war on European engineering trade was published in "Mechanical World" of August 28:

Of the several countries engaged in the present European conflict, it is tolerably evident that Great Britain stands to lose less by trade dislocation than any other. It is true that some of our manufacturing industries have been badly hit, but so far as the engineering trade is concerned a despondent view of the situation is by no means justified. Makers of textile machinery will probably be the worst sufferers, as the continent represents their chief outlet. But as regards general engineering the outlook is much more satisfactory. Certain branches are of course busily employed in meeting the demands of the naval and military authorities, and in these we have every reason to expect a continued period of activity. Makers of structural iron and steel should benefit by the elimination of Belgian and German competition, while, if machine-tool makers find the principal European markets closed against them, they have ample compensation in the absence of German competitors in our large home market. A further advantage we possess over continental competitors is that we are in a position to meet the requirements of colonial and neutral markets now that the western trade routes are open; and hence the present situation provides us with a unique opportunity of consolidating our position in such markets and extending our influence where possible.

The view is held in many quarters that our present trouble may be a blessing in disguise, if it only affords opportunities for recovering some of the industries which we have allowed Germany to filch from us. It is suggested that the refining of lead and other of the baser metals should again find a deal of employment in this country. Again, the manufacture of carbon twist-drills, which has drifted largely into German hands, should be recoverable if suitable plant be installed. This latter proviso is of course almost always a condition of success, and although it requires a considerable amount of courage to expend money under the present circumstances, it is tolerably obvious that those who do so will not have long to wait for their reward once the war cloud shows signs of lifting. Meanwhile, wise economy is to be commended; but the indiscriminate curtailing of business-getting organization, advertising, etc., savors of a penny-wise and pound-foolish policy, the results of which are bound to be the reverse of beneficial.

The building permits for the town of Welland during the month of August this year amounted to $13,625, which shows a decided decrease upon the amount for 1913 of $38,100. The building permits for the year to the end of August, total $314,018; and in 1913, the total shown was $356,996.

The following account has been published relative to building permits issued during the last month in the town of Galt: total estimated cost of permits issued during August, 1914, $92,500; total estimated amount for August, 1913, $40,565. showing an increase of $51,935. The increase is due to the permit which has recently been issued for the construction of an armory at a cost of $80,000.

The Bridle Belt Railway and Navigation Company propose to construct a $50,000,000 terminal project at Seattle, Wash., the initial unit of which is to be undertaken at once at a cost of $15,000,000. This first unit calls for the construction of two docks, each 4 stories high and 200 x 800 ft. These docks will connect with an 8-story building over Railroad Avenue, 500 x 500 ft., which in turn will connect with a 20-story 250 x 500 ft. hotel and office building facing on First Avenue. The hotel and office building will have a total depth below the First Avenue level of 10 stories, the ground floor of which will open on Railroad Avenue.

SUBTERRANEAN WATER AND THE CONSTRUCTION OF A CORE-WALL FOR AN EARTH DAM.

A SUMMARY taken from a letter by Mr. Harrison Souder, published in Proceedings of the American Society of Civil Engineers (Vol. XL., page 1569), deals with the Hinckston Run dam, built 13 years ago near Johnstown, Pa., showing the methods and the results of the employment of grout injection to close underlying rock strata against seepage under the dam. Despite the age of the work, the account is of great interest, for it was not until recently that any matter upon this early use of grout injection was published. Mr. Souder's report, as given in *Engineering and Contracting*, June 10, 1914, is reproduced in the following paragraphs.

The original Hinckston Run project called for an earth dam, 60 ft. high, to retain some 400,000,000 gals. of water, with a depth of 45 ft. at the breast. The intention was to build a dam with a clay core, but, as an unlimited quantity of cinder from the steel plant was available, it was decided, after the work was started, to use this as backing for the dam, in place of earth, and eventually to fill the whole valley below with this material, thus rendering the structure practically unbreakable. In view of this and the additional expense incurred in making the cut-off tight, the proposed height of the dam was increased to 80 ft., and later to 85 ft., above the original creek level. This gave a total maximum height above the bottom of the core-wall ditch of 112.8 ft., a depth of water at the breast of 73½ ft., and a capacity of 1,100,000,000 gals. The lake thus formed is 1¼ miles long. The watershed above the dam is 10.75 square miles.

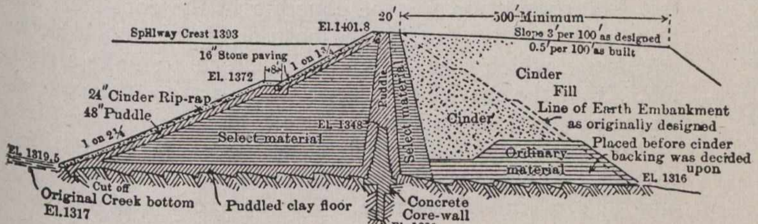

Fig. 1. Maximum Cross Section of Hinckston Run Dam.

The cross-section of the dam as built is shown by Fig. 1. The lower inner slope is 1 on 2¼, with 4 ft. of puddle and 24 ins. of cinder riprap. The slope above the berm is 1 on 1¾ with puddle lining diminishing to 2 ft. thick at the top. The facing is hand-laid stone paving. The puddle wall is 16 ft. thick at the top of the concrete core-wall, and diminishes to 4 ft. at the top of the dam.

When the core-wall ditch had been carried down to hard rock at what was thought to be the proper depth, some test holes were bored through the bottom to determine the character of the rock below. This disclosed a layer of hard sandstone a few feet down, with considerable water flowing below and above it. It was decided to deepen the ditch considerably, in order to get below any rock strata that might come to the surface within the flooded area, and to substitute a concrete core-wall for the clay one originally proposed.

An air compressor plant was installed. This was a 14 x 18-in. Ingersoll-Sergeant machine capable of driving two rock drills and six pneumatic rammers. These rammers were used in tamping concrete and also in puddling clay in such places as could not be covered by a 10-ton steam roller which was also supplied at this time in place of the 3-ton horse roller in use.

The finished ditch averaged in depth 25 ft. below the grubbed surface in the valley, but reached 50 ft. at the ends. The shale was excavated with picks, but the harder rock was loosened with light charges of dynamite, care being taken not to shatter the foundation or open up the seams. The advisability of cutting off the underflow to as great a depth as possible was realized, and it was determined to remove the shale down to the sandstone and try to cut off the flow below by forcing in cement grout under air pressure.

Grout Injection.—Drill holes, 2 ins. in diameter and from 10 to 16 ft. deep, were drilled through the rock, averaging about one hole per linear foot across the valley. Iron pipes, 2 ins. in diameter, 18 ins. long, and threaded on one end, were cemented into these holes. Portland cement grout was poured into them and then air at a pressure of from 30 to 60 lbs. was applied. The first holes were approximately 6 ft. apart. They were drilled generally 10 ft. below bed-rock.

Fig. 2 is a sketch of the first contrivance or receiver devised for applying the grout. It was a cylinder, 8 ins. in diameter and 6 ft. long. A screw flange was provided at top and bottom, and a steel head-plate was bolted to each end, with rubber gasket packing. The top bolt holes were open to allow quick removal of the lid. A 2-in. pipe with plug cocks was provided at the top and bottom. With a short hose, the cylinder was coupled to the pipes in the holes. The cylinder was filled with grout; the valve was opened; the grout ran into the drill holes; and the air pressure was then applied at the top. The contrivance was mounted on a truck running on a track in the bottom of the ditch. After trial it proved to be too slow and cumbersome, and another method was devised and operated satisfactorily. Fig. 3 is a sketch of this final arrangement. The method of grouting was as follows: A 1-in. pipe, long enough to reach to the bottom of the hole, was inserted and air was applied to blow out water and dirt. Then a tee and the pipe, *C*, were attached to the tube in the drill hole with a sleeve union, as shown. The cock, *A*, was closed, the cock, *B*, was opened, and air was applied, thus forcing the water out of the hole and into the crevices and near-by drill holes; meanwhile, the pipe, *C*, was filled with grout, and the air hose was connected at the top. Then *B* was closed, *A* was opened, and air was gradually applied at the top of *C*, forcing the grout down into the crevices. The pipe was refilled about every 10 minutes until the hole would take no more. The apparatus was then removed and a cap was screwed on the

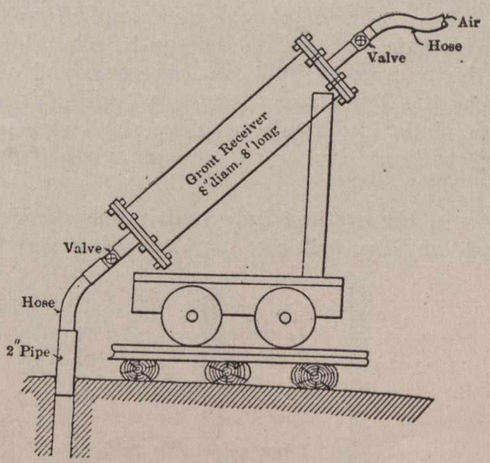

Fig. 2. Grouting Device Tried and Abandoned

tube in the grouted hole. After a given length of ditch was grouted in this way, and sufficient time had elapsed to allow the grout to set, test holes were bored within the grouted area and the process was continued until there was no indication of water flow below the bottom. The greater part of the bottom was grouted successfully in this way, but, as explained later, the grouting scheme was abandoned where the core-wall ditch entered the side-hills.

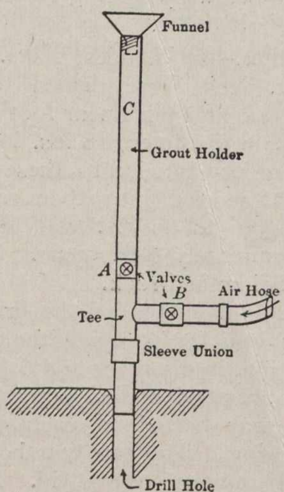

Fig. 3. Grouting Device Employed.

Handling Flow from Seams.—At the east end three large vertical open crevices were uncovered. The flow from these was so considerable that it was necessary to put in a force pump with a 4-in. suction and a 3-in. discharge, in order to keep the ditch clear. As the grouting method, after continued trials, did not give satisfaction at this end, it was decided to take up the bottom until the principal water strata were reached. This was done, and concrete was placed in the ditch, all the walls being plastered first with a rich cement mortar worked in with trowels. Two coats of plaster were applied on the north or reservoir side and one on the south side. The suction pipe of the pump was built in concrete, and carried up with the wall. The strong flow of water in this section of the ditch made it difficult to place the concrete for the core-wall without having the cement washed out before it set.

At first, the method indicated in the sketch, Fig. 4, was tried, namely, a line of 1-in. sheeting was placed as

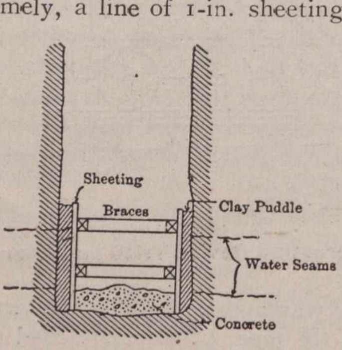

Fig. 4. First Method of Handling Water in Core-Wall Ditch.

shown, and clay was rammed between the sheeting and the rock to stop the water flow. Concrete was placed between the sheeting which was raised gradually as the concrete was carried up. This did not prove wholly satisfactory, and the method of piping the water directly to the sump was adopted, as shown in Fig. 5. This proved successful. Where there was too great a flow of water, plastering could not be done, but considerable neat cement was dumped in along the walls with the concrete and well worked in. After the concrete was well set, the pipes were plugged and the flow of water was shut off. As the concrete was carried up, the water came out of the ditch walls higher up, showing that the underflow had been intercepted. The core-wall ditch was extended well into the hills on each side of the valley, and test holes were bored for water, none being found because, after a certain distance, the rock became hard and massive and free from seams. At the west end of the ditch, there was as much trouble with water. It would seem that the underflow of the whole valley was concentrated at this point, the rest of the ditch having been grouted and the flow cut off.

The drill-hole grouting method failed in the west side of the valley, as in the east, and here the bottom was also taken out, down to the water strata, and the water fought inch by inch by piping it from the streams to the sump, as before described, and the ditch was completely filled with concrete.

The proportion for the concrete in the core-wall was 1 : 2 : 5, generally; but, at the bottom, it was much richer in cement, which was not spared in efforts to make a tight job. Near the crevices a proportion of 1 : 1 : 2½ was used. These proportions had to be varied, also, to suit the sizes of the stone supplied, which varied from ½ in. at times to 3 in. The top section of the wall was made of 1 : 3 : 6 and 1 : 3 : 7 cinder concrete. The concrete was mixed in a machine of the continuous-mixer type, consisting of a long square revolving box with a helix at the back. The

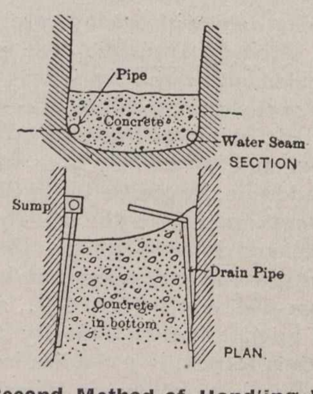

Fig. 5. Second Method of Handling Water in Core-Wall Ditch.

machine was not wholly satisfactory, but was the best to be had. The concrete was received in ½-cu. yd. dump buckets, carried on small trucks running on light track to the derricks; it was then lowered to the bottom of the ditch and dumped, as it was not thought advisable to drop it from any height. At first a middling dry concrete was required, but, later, a wet concrete was found to give the best results and was finally adopted for the remainder of the work.

After the core-wall reached above the surface the faces received two coats of plaster, one inside against the wood forms and another after the forms were removed. For the upper part of the wall, the plaster coat on the down-stream side was omitted; and, on the up-stream side, a cement wash applied with a brush was substituted for the second coat of plaster. Where sections of the wall joined, bonding grooves were provided.

The concrete core-wall contained 10,840 cu. yds. and required 13,166 bbls. of cement, or an average of 1.21 bbls. per cubic yard. The grouting and plastering took 2,078 bbls. of cement, in addition. The exact quantity of cement used in grout alone is not known.

SOME TUNNELING COSTS.

THE United States Bureau of Mines has made exhaustive investigation into the subject of mine tunneling, and, in the course of the work, found that data respecting tunneling costs were remarkably scarce. The Bureau thereupon undertook to gather the available data, which have been published in a recent bulletin from which the following statistics have been complied:—

Los Angeles Aqueduct.

Little Lake Division, Tunnels 1 to 10A.

Location: Inyo County, Cal.

Purpose: Water supply, power and irrigation.

Cross-section: Straight walls, arched roof, dished bottom.

Size: 7 feet 10 inches wide by 8 feet 5 inches wide.

Type of power: Electric power purchased at a nominal cost per kilowatt-hour from a hydraulic plant constructed and owned by the aqueduct.

Ventilators: Pressure blowers.

Size of ventilating pipe: 12 inches.

Drills: Pneumatic hammer, usually 2 in each heading.

Mounting of drills: Horizontal bar.

Number of holes per round: Usually 14 to 16.

Average depth of round: 6 to 10 feet.

Number of drillers and helpers per shift: 2 drillers and 2 helpers.

Number of drill shifts per day: Usually 1, but sometimes 2.

Explosive: 40 per cent. gelatine dynamite, with some 20 per cent. and some 60 per cent. Ammonia dynamite also tried.

Number of muckers per shift: Usually 5.

Number of mucking shifts per day: Usually 1, but 2 when 2 drill shifts were employed.

Type haulage: Tunnels 1 to 3-N, mules; tunnels 3-S, to 10A-N, electric; tunnel 10A-S, mules.

Wages: Drillers and helpers $3, muckers, $2.50, blacksmiths $4, helpers $2.50, motormen $2.75, dumpmen $2.50.

Tunnel 1B-S, Length 1,341 Feet.

(Through medium-hard granite at an average speed of 225 feet per month.)

	Cost per foot of tunnel.
Excavation	$ 9.15
Engineering	.18
Adit proportion	.28
Permanent equipment (estimated)	2.35
Timbering (857 feet)	1.02
	$12.98

In this tunnel, as in all of the tunnels of this division and of the Grapevine division, the cost of excavation includes the wages of shift foremen, drillers, helpers, muckers, motormen or mule drivers, dumpmen, blacksmiths and helpers, machinists, electricians (part), and power engineers; also the cost of powder, fuse caps, candles, light globes, machine oil, blacksmith supplies and fuel, and machinists' supplies, and the cost of power and of repairs for power, haulage, compressor, and ventilating machinery.

"Engineering" includes the cost of giving line and grade, etc.

"Adit proportion" is a proportionate charge per foot of tunnel to defray the cost of an adit from the surface to the tunnel line.

"Permanent equipment" costs were not segregated for each tunnel, but were compiled for the whole division, so the charge represents a proportionate charge per foot for the entire division cost, without salvage, of trolley and light lines, including freight and cost of installation; pressure air lines with freight and installation; ventilation lines with freight and installation; water lines with freight and installation; mine locomotives and cars, picks, shovels, drills and drill sharpeners, with repairs for the last four items.

Tunnel 2, Length 1,739 Feet.

(Through medium-hard but very wet granite at an average speed of 170 feet per month.)

	Cost per foot of tunnel.
Excavation	$ 8.81
Engineering	.19
Adit proportion	.34
Permanent equipment	2.35
Timbering (1,590 feet)	3.28
	$14.97

Tunnel 2-A, Length 1,322 Feet.

(Through medium-hard granite at an average speed of 150 feet per month.)

	Cost per foot of tunnel.
Excavation	$ 8.05
Engineering	.16
Adit proportion	.34
Permanent equipment	2.35
Timbering (1,322 feet)	2.51
	$13.41

Tunnel 3-N for 1,148 Feet.

(Through medium-hard granite at an average speed of 150 feet per month.)

	Cost per foot of tunnel.
Excavation	$10.10
Engineering	.23
Adit proportion	.51
Permanent equipment	2.35
Timbering (956 feet)	2.44
	$15.63

Tunnel 3-S for 1,358 Feet.

(Through granite of variable hardness and containing pockets of carbon-dioxide gas, at an average speed of 155 feet per month.)

	Cost per foot of tunnel.
Excavation	$12.38
Engineering	.28
Adit proportion	.16
Permanent equipment	2.35
Timbering (1,244 feet)	3.28
	$18.45

Tunnel 3, Length 4,044 Feet.

(Through decomposed granite of medium hardness, dissected by slips and talcose planes requiring timber where ground was wet, and also containing pockets of carbon-dioxide gas, making work difficult and requiring extra provisions for ventilation. Average speed, 140 feet per month.)

	Cost per foot of tunnel.
Excavation	$12.67
Engineering	.24
Adit proportion	.35
Permanent equipment	2.35
Timbering (3,570 feet)	2.71
	$18.32

Tunnel 4, Length 2,033 Feet.

(Through medium-hard to hard granite at an average speed of 145 feet per month.)

	Cost per foot of tunnel.
Excavation	$12.00
Engineering	.24
Adit proportion	.16
Permanent equipment	2.35
Timbering (1,705 feet)	2.16
	$17.01

Tunnel 5, Length 1,178 Feet.

(Through medium-hard to very hard granite at an average speed of 120 feet per month.)

	Cost per foot of tunnel.
Excavation	$11.10
Engineering	.21
Adit proportion	.08
Permanent equipment	2.35
Timbering (916 feet)	1.83
	$15.57

Tunnel 7, Length 3,596 Feet.

(Through biotite granite of variable hardness at an average speed of 140 feet per month.)

	Cost per foot of tunnel.
Excavation	$13.55
Engineering	.27
Adit proportion	.13
Permanent equipment	2.35
Timbering (3,609 feet)	3.60
	$19.90

Tunnel 8-S for 1,334 Feet.

(Through medium-hard to hard granite at an average speed of 135 feet per month.)

	Cost per foot of tunnel.
Excavation	$12.82
Engineering	.19
Adit proportion	.18
Permanent equipment	2.35
Timbering (126 feet)	.39
	$15.93

Tunnel 9 for 3,506 Feet.

(Through medium hard to hard granite at an average speed of 195 feet per month.)

	Cost per foot of tunnel.
Excavation	$12.19
Engineering	.18
Adit proportion	.07
Permanent equipment	2.35
Timbering (305 feet)	.29
	$15.08

Tunnel 10 for 5,657 Feet.

(Through medium-hard to hard granite at an average speed of 200 feet per month.)

	Cost per foot of tunnel.
Excavation	$13.50
Engineering	.19
Permanent equipment	2.35
Timbering (194 feet)	.11
	$16.15

Tunnel 10A-N for 1,496 Feet.

(Through medium-hard to hard granite at an average speed of 165 feet per month.)

	Cost per foot of tunnel.
Excavation	$13.02
Engineering	.13
Permanent equipment	2.35
Timbering (24 feet)	.78
	$16.28

Tunnel 10A-S for 2,200 Feet.

(Driven through medium-hard to hard granite at an average speed of 200 feet per month.)

	Cost per foot of tunnel.
Excavation	$12.37
Engineering	.20
Permanent equipment	2.35
Timbering (215 feet)	1.15
	$16.07

GRAPEVINE DIVISION TUNNELS.

Location: Kern County, Cal.

Purpose: Water supply, power and irrigation.

Cross-section: Straight walls, arched rod, dished bottom.

Size: 7 feet 10 inches wide by 8 feet 5 inches high.

Type of power: Electric power purchased from aqueduct plant.

Ventilators: Pressure blowers.

Size of ventilation pipe: 12 inches.

Drills: Pneumatic hammer, usually 2 in each heading.

Mounting of drills: Horizontal bar.

Number of holes per round: Usually 18 to 20.

Average depth of round: 6 to 8 feet.

Number of drillers and helpers per shift: 2 drillers and 2 helpers.

Number of drill shifts per day: Usually 2.

Explosive: 40 per cent. ammonia dynamite, but 60 per cent. and 75 per cent. gelatine dynamite were employed in hard ground.

Number of muckers per shift: 4 or 5.

Number of mucking shifts per day: Usually 2.

Type of haulage: Electric after the first 400 to 500 feet.

Wages: Drillers and helpers $3, muckers $2.50, blacksmiths $4, helpers $2.50, motormen $2.75, dumpmen $2.50.

Tunnel 12, Length 4,900 Feet.

(Through hard granite at an average speed of 185 feet per month.)

	Cost per foot of tunnel.
Excavation	$22.10
Engineering	.32
Permanent equipment	2.35
Timbering (90 feet)	.08
	$24.75

Tunnel 13 for 1,525 Feet.

(Through hard granite at an average speed of 130 feet per month.)

	Cost per foot of tunnel.
Excavation	$20.60
Engineering	.10
Permanent equipment	2.25
Adit proportion	.37
	$23.32

Tunnel 14, Length 859 Feet.

	Cost per foot of tunnel.
Excavation	$22.70
Engineering	.13
Permanent equipment	2.25
Adit proportion	.72
Timbering (22 feet)	.16
	$25.96

Tunnel 15, Length 895 Feet.

	Cost per foot of tunnel.
Excavation	$23.28
Engineering	.11
Permanent equipment	2.25
Adit proportion	2.42
	$28.06

Tunnel 16, Length 2,723 Feet.

(Through hard granite at an average speed of 145 feet per month.)

	Cost per foot of tunnel.
Excavation	$20.07
Engineering	.17
Permanent equipment	2.25
Adit proportion	.55
Timbering (18 feet)	.04
	$23.08

Tunnel 17, Length 3,024 Feet.

	Cost per foot of tunnel.
Excavation	$20.47
Engineering	.21
Permanent equipment	2.25
Timbering (142 feet)	.22
	$23.15

Tunnel 17½ for 1,345 Feet.

(Through medium-hard to hard granite at an average speed of 225 feet per month.)

	Cost per foot of tunnel.
Excavation	$19.56
Engineering	.31
Permanent equipment	2.25
	$22.12

Tunnel 17A for 3,275 Feet.

	Cost per foot of tunnel.
Excavation	$18.70
Engineering	.17
Permanent equipment	2.25
Timbering (441 feet)	1.18
	$22.30

Tunnel 17B for 4,915 Feet.

	Cost per foot of tunnel.
Excavation	$21.09
Engineering	.21
Permanent equipment	2.25
Timbering (163 feet)	1.90
	$25.45

Elizabeth Division, Elizabeth Lake Tunnel.

Location: Los Angeles County, Cal.

Purpose: Water supply, power and irrigation.

Cross-section: Rectangular, with arched roof.

Size: 12 by 12 feet.

Length: 26,870 feet.

Type of power: Electric power purchased from aqueduct plant.

Ventilator: Pressure blower.

Size of ventilating pipe: 18 inches.

Drills: Pneumatic hammer, 3 in the south heading and 2 in the north.

Mounting of drills: Horizontal bar.

Number of holes per round: 25 in the south heading, 16 in the north heading.

Average depth of round: 8 to 10 feet.

Number of drillers and helpers per shift: 2 drillers and 2 helpers at the north end, 3 drillers and 3 helpers at the south end.

Number of drill shifts per day: 3.

Explosive: 40 per cent. and 60 per cent. gelatine dynamite.

Number of muckers per shift: 6.

Number of mucking shifts per day: 3.

Type of haulage: Electric.

Wages: Drillers and helpers $3, muckers $2.50, blacksmiths $4, helpers $2.50, motormen $2.75, dumpmen $2.50.

Maximum progress in any calendar month: 604 feet, April, 1910.

Average monthly progress per heading: 350 feet per month.

North Heading, Elizabeth Lake Tunnel.

(Through altered granite, requiring much timbering, 13,370 feet.)

	Cost per foot of tunnel.
Drilling and blasting	$11.25
Mucking and tramming	11.70
Engineering and superintendence	1.27
Drainage	.45
Ventilation	.22
Light and power	5.55
Timbering (13,031 feet)	8.48
Cost of auxiliary shaft	.93
Permanent equipment (full charge, no salvage; estimated)	3.70
	$43.55

South Heading, Elizabeth Lake Tunnel.

(Through medium-hard to hard granite, requiring but little timbering, 13,500 feet.)

	Cost per foot of tunnel.
Drilling and blasting	$14.65
Mucking and tramming	11.10
Engineering and superintendence	.86
Drainage	.17
Ventilation	.41
Light and power	4.93
Permanent equipment (without salvage; estimated)	3.70
Timbering (3,424 feet)	2.19
	$38.01

LUCANIA TUNNEL.

Location: Idaho Springs, Colo.

Purpose: Mine development and transportation.

Cross-section: Square.

Size: 8 by 8 feet.

Length: 12,000 feet projected; 6,385 feet driven December 1, 1911.

Character of rock penetrated: Hard granite.

Type of power: Purchased electric current.

Ventilator: Pressure blower.

Size of ventilating pipe: 18 and 19 inches.

Drills: Pneumatic hammer, 3 in the heading.

Mounting of drills: Vertical columns.

Number of holes per round: 25.

Average depth of round: 8 to 9 feet.

Number of drillers and helpers per shift: 3 drillers and 2 helpers.

Number of drilling shifts per day: 1.

Explosive: 50 per cent. gelatine dynamite.

Number of muckers per shift: 3.

Number of mucking shifts per day: 1.

Type of haulage: Horses.

Wages: Head driller $5, drillers $4, nipper $3.50, boss mucker $5, muckers $4, drivers $4, power engineers $4, blacksmith $5.

Maximum progress in any calendar month: 263 feet, September, 1911.

Average monthly progress: 125 feet per month for the first 4,800 feet, 240 feet per month for the last 1,575 feet.

Average Cost of Driving First 4,800 Feet.

	Cost per foot of tunnel.
Labor	$ 8.86
Powder	7.86
Fuse and caps	.17
Candles and oil	.21
Horse feed and shoeing	.18
Power	1.64
Repairs	.14
Tunnel equipment	2.75
Surface plant	1.25
	$23.06

"Tunnel equipment" includes the cost of materials and installation of the pressure air line, the ventilating line, rails, ties and fittings, and the drainage ditch. "Surface plant" includes buildings, compressor, blower, transformers, motors and drill sharpener.

Cost of Driving Next 1,575 Feet.

The contractor received $21.50 per foot to cover the cost of labor, powder, fuse, caps, candles, oil, horse feed and shoeing, power and repairs, and the installation of the tunnel equipment.

(To be continued.)

REMARKABLE SPEED IN BRIDGE BUILDING.

Since the establishment of the Canadian military camp at Valcartier, Que., there has been much accomplished that reflects credit upon the manner in which the engineering features of the camp have been handled. First, it took but a few days for the Canadian Northern Railway to transform a small flag station into an important terminal point with twenty miles of railway sidings, giving a splendid impetus to the establishment of the camp and expediting the movement of the men and materials which went to make this city of thirty thousand souls.

Now comes news of a bridge-building record made by the men of the Royal Canadian Engineers under the direction of Major W. Bethune Lindsay, of Winnipeg. The Jacques Cartier River separates the main camp from the artillery practice grounds at the base of Mounts Ileene and Irene. Across this 350 feet of waterway, the Royal Canadian Engineers built in four hours, a barrel-pier pontoon bridge, capable of carrying heavy batteries. The major and his three hundred men worked with that well ordered efficiency which characterizes the efforts of the British bred. The race for the record started with the Canadian Northern Railway. The materials—barrels, planking, etc., were freighted on to the ground with remarkable despatch. The casks were made watertight, the timber was made ready, the twenty-foot bank cut down to provide an easy grade for traffic, and the actual test was on.

There is a telephone for every 15.2 persons in Canada, according to official figures.

Promising surface indications of petroleum deposits in Spain have led the government to investigate the discoveries.

Editorial

HAMILTON-TORONTO PERMANENT HIGHWAY.

The plan to proceed without delay on the construction of a $600,000 permanent highway between the cities of Hamilton and Toronto is a very commendable one. Besides providing a thoroughfare for which there has been a distinct need, this work will be a boon to many unemployed in the two terminal cities and in the intervening municipalities.

Various organizations, including city and town councils, boards of trade, automobile, farmers' and fruit-growers' associations, etc., have emphasized for a considerable length of time the necessity for a permanent road which, when constructed, would serve over half a million people. The road will run through fruit and vegetable farming communities for practically its entire length and will be a means of bringing producer and consumer closer together here than it is possible to find them elsewhere in the Dominion. The phrase "deplorable condition" has been associated with the present Lake Shore Road for the greater part of many seasons. This state is very regrettable considering the usefulness of an improved inter-city highway, its picturesqueness and the absence of engineering difficulties along its path.

Last week a program was decided upon by the Provincial Government whereby Toronto and Hamilton will contribute $150,000 and $30,000 respectively, while the counties through which the projected road will pass will assist at the rate of $4,000 per mile. A commission was also appointed to properly manage these funds, to select the route, concerning which, for a small portion of the distance, there has been some controversy, to decide the type of pavement and to take charge of the construction. This commission consists of Geo. H. Gooderham, M.P.P., Toronto; G. Frank Beer, Toronto; T. W. Jutton, Hamilton; M. C. Smith, Burlington; and C. G. Marlatt, Oakville.

The last report of the Public Roads and Highways Commission of Ontario very strongly emphasized the need of this permanent inter-city route. One of its chief recommendations for this season's work constituted a preliminary survey of the line. The government authorized this procedure last winter, and Mr. W. A. McLean, the Provincial Highway Engineer, has had a staff of men engaged upon the work for a greater part of the summer. Hence, little time need be spent upon preliminaries.

What remains of the road-making season has been reduced to a matter of days, but before the interference of severe weather, any necessary re-location may be made, grading may be proceeded with and materials collected. This may mean the employment of from 500 to 700 men.

It is just such undertakings as these, involving the services of large gangs of men, that our cities and towns should hasten to proceed with, in order to reduce as much as possible the distress and want which follows in the wake of unemployment.

ANNOUNCEMENT

In view of the present political conditions in Germany and Austria, which constitute a menace to Canadian interests, *The Canadian Engineer* feels fully justified in excluding from its pages the advertisements of any machinery or materials made in Germany or Austria that can be supplied by Canadian firms, by firms situated anywhere within the British Empire, or by firms in the friendliest of neutral countries, the United States.

ENGINEERS' LIBRARY

Any book reviewed in these columns may be obtained through the Book Department of The Canadian Engineer.

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BOOK REVIEWS.

Influence Diagrams for the Determination of Maximum Moments in Trusses and Beams. By Malverd A. Howe, C.E., Professor of Civil Engineering, Rose Polytechnic Institute. Published by John Wiley & Sons, New York; Canadian consulting agents, Renouf Publishing Co., Montreal. 65 pp.; 42 illustrations; 6x9 in.; cloth. Price, $1.25.

This is the first edition of a very useful work which explains the method of applying influence lines in the analysis of trusses, arches and beams. While their use is not new, the book has for its object the directing of attention to the fact that for loads on all ordinary trusses the influence diagrams for bending moments may be drawn by following a single simple rule and that no computations are required for the direct application of such diagrams when so constructed. In addition, it also brings out the fact that these influence diagrams for loads on continuous trusses, cantilever trusses and arches are based upon the one general diagram for simple trusses. Moreover, the author makes it clear that although the diagrams shown in the book are constructed for moments, yet they can be as easily drawn to indicate stresses or even areas of truss members.

The work is divided into five chapters: Simple trusses, double intersecting trusses, continuous trusses, arches and beams of constant section.

The definition of influence line as given by the author is a very convenient one, viz., "an influence line is one which shows the effect of a unit load moving across a structure upon any function of the structure for any position of the load." As might be expected, the work contains many technical calculations, but they are well illustrated in the diagrams and carefully explained in the text.

The work is well printed and bound, and a structural engineer will find it a valuable addition to his library.

Lackawanna Handbook. Published by the Lackawanna Steel Co., Buffalo, N.Y. 456 pp.; size 4x6½ in.; flexible leather binding. Price, $2.00.

This is a 1915 edition of a handbook containing some very useful information for engineers, architects and builders. It comprises diagrams, dimensions and weights of structural steel sections, special shapes merchant bars, sheet steel filing, standard heavy and light rails, track accessories, etc. The usual mathematical tables required in the use of such products are included. Among them might be mentioned the properties of rolled sections; the dimensions, properties and safe loads of steel columns and struts, and the dimensions and safe loads of girders and beams. The handbook also contains mensuration formulæ, notes on roofs and roof trusses, tables of weights, measures, specific gravities and others for arithmetical and logarithmic use.

Waterworks Engineering. By Fred. C. Uren, M. Inst. C.E. Published by Castle Litho, Limited, Bristol, Eng. 270 pp.: 186 illustrations besides numerous plates; size 6x9½ in.; cloth.

The author's wide experience in waterworks engineering, comprising company, local authority and parliamentary work is reflected throughout this book, which will be found a practical treatise on the construction of waterworks and therefore of benefit to engineers and engineering students. The work fills a want that has been more or less ignored by many volumes on waterworks engineering that have appeared throughout recent years. The theoretical side of the question has been treated with special brevity in order to devote all possible space to details of actual construction of small and large undertakings from their incipient stages to completed works. The author has recognized the fact that improvements that recent years have brought about in many phases of design and construction, have almost revolutionized former practice; hence, such sections as those on earthen and masonry dams, geology and well boring, distribution and purification, have been given special attention.

The following constitute the chapter headings: Sources—Storage; Impounding Reservoirs, Masonry Dams; Earthwork Dams; Reservoir Accessories; Rivers and Streams; Well Construction and Boring; Geology, Yield of Wells; Service Reservoirs; Raising Water from Wells; Motors for Pumps; Calculating the Dimensions of Pumps and Engines; The Flow of Water in Pipes and Channels; Gauging Water; The Purification and Softening of Water; Distribution and Utilization; Watermains and Accessories; Service Pipes and House Fittings; Metered Supplies, Waste Detection; Administration and Maintenance; and, The Law of Waterworks.

Work, Wages and Profit. By H. L. Gantt. Published by the Engineering Magazine Co., New York. 312 pp.; 27 illustrations; size 5x7 in.; cloth. Price, $2.00.

This is the second edition of Mr. Gantt's book. It is considerably revised and enlarged over the first edition which appeared in 1910. The author has taken advantage of the rapid rise that has taken place in public attention to the methods used and the results secured in the application of scientific management to the various industries. In his preface the author is cautionary concerning sudden changes of management for purposes of inaugurating the principles of modern industrial organization into an industry. He states: "The man who undertakes to introduce scientific management and pins his faith to rules, and the use of forms and blanks, without thoroughly comprehending the principles upon which it is based, will fail. Forms and blanks are simply the means to an end. If the end is not kept clearly in mind, the use of these forms and blanks are apt to be detrimental rather than beneficial."

The work goes a long way towards explaining the principles of modern industrial organization and outlines how to utilize the methods of evolution in the introduction of a system of management based upon these principles. The author's experience in the field of labor management extends over 25 years of close practical application and his own special methods are well known, although perhaps partially or imperfectly understood by many. The book outlines to the full his concept of scientific investigation according to standardization, individual instruction, and interconnected reward to both instructor or supervisor and workman.

The illustrations are for the most part in the form of colored charts, representing conditions associated with scientific management in machine shop, metal working, locomotive building plants, etc.

In its entirety the work offers an interpretation of industrial conditions and a promise for betterment that makes it of extreme value to the managers of industry.

Sub-Aqueous Foundations. By Chas. E. Fowler, M. Am. Soc. C.E., M. Can. Soc. C.E., etc. Published by John Wiley & Sons, New York; Canadian selling agents, Renouf Publishing Co., Montreal. 814 pp.; 477 illustrations; size 6 x 9 in.; cloth.

This extensive treatise on Sub-aqueous Foundations is the third edition of Mr. Fowler's work, considerably revised and enlarged. It includes in revised form the material of several previous publications by the author, the cofferdam process for piers, and dredges and dredging. It is a practical treatment of the whole subject containing numerous examples from actual work. This latter characteristic largely constitutes a new matter incorporated in the third edition. They relate to structures that have had the test of time and use. Many of them were constructed by the author or were under his supervision in a consulting capacity.

The use of compressed air in caisson work has been conspicuously added to, while an entire chapter has been devoted to the use of launches, tugs and scows, as required in foundation work. Characteristic of the publication is the data also on the bearing power of soils, on friction in pile and caisson work and on the quarrying of rock. Entirely new matter has been given on piers and wharves; dams, sea walls and retaining walls; dry docks and locks; cost of construction work, the two chapters on this latter subject covering the subject of foundations so well that the engineer in possession of the volume will find it quite adequate as a source of information to properly execute his work.

The following list of chapter headings is sufficient evidence of the comprehensiveness of the book, and engineers familiar with the author's previous contributions to literature on the subject no doubt find therein sufficient new matter to assure them that the book will fill a very important place:

Historical Development; Construction and Practice—Crib Cofferdams; Construction and Practice—Cribs and Canvas; Pile-Driving and Sheet-Piles; Jetting Piles; Construction with Sheet-Piles; Metal Construction; Cylinders and Caissons; Open Dredged Caissons of Timber; Timber Pneumatic Caissons; Steel Pneumatic Caissons, Forth Bridge; Divers and Diving; Removing Old Piers; Pumping and Dredging; Clam-shell Dredges, Drill Scows and Rock Breakers; Dipper and Ladder Dredges; Suction and Hopper Dredges; Tugboats and Scows; The Foundation; Location and Design of Piers; Rock Fill Foundations and Quarries; Calculation of Piers, Footing and Retaining Walls; Cement and Concrete; Foundations for Piers and Wharves; Timber Piers and Timber Preservation; Foundations for Dams, Sea Walls, and Breakwaters; Foundations for Docks and Locks; Forms for Concrete; Estimating the Cost.

Symmetrical Masonry Arches. By Malverd A. Howe, M. Am. Soc. C.E., professor of Civil Engineering, Rose Polytechnic Institute. Published by John Wiley & Sons, New York; Canadian selling agents, Renouf Publishing Co., Montreal. 245 pp.; 35 illustrations; 6 folding drawings; size 6 x 9 in.; cloth. Price, $2.50.

This is the second edition of Professor Howe's treatise on the design of masonry arches according to the elastic theory. Most of the text has been rewritten and a considerable amount of new matter added, while demonstrations of the formulas presented in the previous edition have been materially simplified. The author has employed the unit load method throughout the work, claiming it to be the only satisfactory method to use if maximum stresses are desired.

In order to facilitate a ready solution of the ordinary problems, such as are encountered by the engineer during his regular practice, a greater portion of the book is taken up with the solution of examples, each step being given in detail so as to be readily followed by the engineer or engineering student who has not specialized particularly along this line.

The general subject is treated under the divisions of: Fundamental Formulas; Symmetrical Arches fixed at the ends (2 chapters); Examples showing the application of the formulas; and Typical Arches.

The work relates generally to masonry arches of natural stone, plain concrete and reinforced concrete. Appendices to the general text are as follows: Physical properties of stone and concrete; Data for about 600 arch bridges.

PUBLICATIONS RECEIVED.

Queen Victoria Niagara Falls Park.—28th annual report of the Commissioners (1913). 42 pages; illustrated; size, 6 x 9 in.

Hydro-Electric Power as Applicable to the Farm.—Evidence given before select standing committee on Agriculture and Colonization, Canada.

Experiments with Furnaces for a Hand-Fired Return Tubular Boiler.—Technical Paper No. 34 of the United States Bureau of Mines. 32 pages; size, 6 x 9 in.

Association of Ontario Land Surveyors.—Proceedings of the 22nd annual meeting, held in Toronto, February, 1914. It contains reports of committees, papers, list of members, etc.

Electric Lights for Use About Oil and Gas Wells.—Technical Paper No. 70 of the United States Bureau of Mines outlining danger from use of ordinary electric lights, suggested specifications, etc.

Ontario Good Roads Association.—Proceedings of the 12th annual meeting, appended to the annual report of the

Commissioner of Highways. It contains the papers, discussions and reports of the February, 1914, meeting.

Proportioning Aggregates for Portland Cement Concrete.—Reprint of paper by Albert Moyer from the proceedings of the American Society for Testing Materials. Issued by the Vulcanite Portland Cement Co., New York.

Accidents from Falls of Rock or Ore.—A circular issued by the United States Bureau of Mines outlining the causes and prevention of accidents from such falls under different conditions of mining, and general hints to miners on the subject.

Forestry.—Report for 1913 of the Director of Forestry, Department of the Interior, Canada, containing the reports also of district inspectors, inspector of fire ranging, and reconnaissance surveys in various Provinces. 136 pages; illustrated.

Trent Watershed Survey.—Map illustrating forest distribution and diagram showing classification of land to accompany previous report of the Commission of Conservation, Ottawa, on the Trent Watershed Survey (already reviewed in these columns).

Tabulation of Water Rates.—Report of Committee on Tabulation of Water Rates and other information of interest to water companies. 337 pages; size, 6 x 9 in.; reprinted from the Journal of the American Waterworks Association, for June, 1914.

Centrifugal Compressors.—By Louis C. Loewenstein, Issued by the Canadian General Electric Co., and reprinted from the General Electric Review. A very comprehensive discussion of the design, construction and operation of centrifugal compressors.

Lands, Forests and Mines.—Report for 1913 of the Minister of Lands, Forests and Mines of the Province of Ontario, including statements and reports of officers, surveyors, superintendents and of Mr. J. F. Whitson on the construction of roads in Northern Ontario.

The Pre-Cambrian Geology of Southeastern Ontario.—By W. G. Miller and C. W. Knight, of the Bureau of Mines of Ontario. The report also contains an appendix on the co-relation of the Pre-Cambrian rocks of Ontario, Western Quebec and Southeastern Manitoba.

Mother Lode and Sunset Mines, Boundary District, B.C.—Memoir No. 19, of the Geological Survey, Department of Mines, Canada. Compiled by O. E. LeRoy. It covers the general character of the district, its general and economic geologies and detailed description of the mines.

Clay and Shale Deposits of the Western Provinces.—Part No. 3.—By Heinrich Ries. Memoir No. 47 of the Geological Survey, Department of Mines, Canada. Report of the 1912 investigation of the Survey, including field work and results of tests of samples from a large number of localities in Western Canada.

Factors Governing the Combustion of Coal in Boiler Furnaces.—A 44-page preliminary report issued by the United States Bureau of Mines. It describes the equipment and character of tests constituting an extensive investigation; the coal used; results of the experiments; and discussion of results of tests.

Big Creek Initial Development.—1914 report of the Stone and Webster Construction Co., describing their work in connection with 4 dams, 2 tunnels, 2 power-houses, 2 240-mile transmission lines, sub-station and 56-mile railroad for the Pacific Light and Power Corp. Beautifully illustrated with photographs and colored map.

The Origin of Coal.—Bulletin No. 38, United States Bureau of Mines. 390 pages; illustrated; size, 6 x 9 in. It deals with the geologic relations of coals; analysis of samples; physiographic conditions attending coal formation; rate of deposition; origin and formation of peat; microscopic study of coal, and conclusions.

The Young Man and the Electrical Industry.—A reprint by the Westinghouse Electrical and Manufacturing Co. of an article by Jas. H. Collins dealing with the opportunity afforded a young man in the industry and the different lines in which he may direct his activities as exemplified in the works of that company. Article appeared in "Scientific American," May 16th, 1914.

International Joint Commission.—Opinions, reports of hearings and arguments, and orders of the International Joint Commission in the matter of (1) the application of the Michigan Northern Power Co. for approval of the obstruction, diversion and use of St. Mary's River water on the United States side of the boundary at Sault Ste. Marie, and (2) the application of the Algoma Steel Corp. upon the same problem.

Vitrified Brick, Pavements and Highways.—Specifications for the construction of vitrified brick street pavements and highways, being the 1914 revised edition issued by the National Paving Brick Manufacturers' Association. The specifications cover grading; drainage; stone curbing; concrete foundation; cushion; expansion joints; brick; bricklaying and inspection; rolling; cement grout filler; alternative concrete curbing; with similar specifications concerning cement-filled brick pavement; crushed stone; old gravel or macadam foundation; sand filler; in the case of each, i.e., street pavements and highways.

Poor's Manual of Industrials for 1914 (fifth annual number).—The book contains 2,500 pages, or about 300 pages more than any previous issue. About 750 new companies have been added and many new income accounts and balance sheets. These tables are mostly in comparative form. In addition, the Manual contains an appendix, giving late information on the Railroads and Utilities, supplementing these two Manuals. The publication of this volume completes Poor's Manual for 1914. The three books together contain over 6,500 pages, covering the entire field of corporate investment in America. They give statements of practically every corporation in which there is a public interest, and are noted for their accuracy, completeness and thoroughness.

CATALOGUES RECEIVED.

Morris Overhead Runway.—An illustrated bulletin of the Herbert Morris Crane and Hoist Co., Limited, Toronto, describing the "Q. E. F." type of runway as to capacities, construction, accessories, etc.

Storage Battery Locomotives.—A 4-page leaflet issued by the Canadian Westinghouse Co., Limited, Hamilton, Ont., descriptive of the Baldwin-Westinghouse Storage Battery Locomotives, as built in two types for mining and industrial service.

Work Done.—A 48-page illustrated booklet issued by Westinghouse, Church, Kerr and Co., New York, descriptive of some of the work which they have done for industrial plants. The work includes railways, steam and electric, as well as the design and construction of complete plants, etc.

Oil and Gas-Burning Appliances.—An 8-page bulletin issued by the Quigley Furnace and Foundry Co., Springfield, Mass., descriptive of appliances for burning oil and gas fuel, including burners, blowers, strainers, separators, regulating valves, gauges, storage tanks, pumping systems, etc.

Evidence as to Pavements.—A handsomely illustrated booklet published by the Barber Asphalt Paving Company, Philadelphia, describing the work done by them in various cities of the United States, and outlining the durability of such pavements as evidenced by many instances in which they are more than 20 years old.

Rail Bonds and Bonding Tools.—A catalogue issued by the Canadian General Electric Co., Toronto, and containing information on rail bonds and rail bond tools for various requirements. Recent improvements are described and a considerable quantity of engineering data included. The catalogue is well illustrated and covers 54 pages.

Floor and Ceiling Plates.—A catalogue of special interest to heating and plumbing trades descriptive of various types of plates, automatic wood wheel and key valves, self-cleaning water gauges and various other accessories for steam and hot water systems. Published by the Beaton and Cadwell Manufacturing Co., New Britain, Conn.

Lagonda Multiple Strainers.—It describes a strainer manufactured by the Lagonda Manufacturing Co., Springfield, O., for water intake lines of power plants and pumping stations for the removal of solid matter without any interruption to flow. The catalogue contains much descriptive information; it is well illustrated, and covers 20 pages.

Railway Motor Gears and Pinions.—A 20-page bulletin issued by the Canadian General Electric Co., Toronto, describing their various grades of gears and pinions. The description covers solid cast-steel, split cast-steel and forged gears. It explains their construction and gives some valuable gear formulæ, together with tables of classification and dimensions.

Oil and Gas Engines.—A 50-page catalogue issued by the August Mietz Iron Foundry and Machine Works, New York, descriptive of Mietz and Weiss oil and gas engines, stationary and marine, for operation by kerosene, alcohol, fuel oil, distillate and crude oil; 2 to 400 h.p. Also a catalogue descriptive of Mietz and Weiss marine oil engines, reversing friction clutches, starters, etc.

Chloride and Tutor Accumulators.—A 24-page catalogue issued by the Canadian General Electric Co., Limited, Toronto, descriptive of these types of accumulators for electric railways, central and isolated lighting and power plants, interlocking switch and signal service, telephone, telegraph, fire alarm, laboratory and small motor work. The catalogue describes both types in detail as to sizes, capacities, working conditions, parts, etc.

Measuring Tapes and Rules.—A handsomely illustrated and well-bound 110-page catalogue published by the Lufkin Rule Co. of Canada, Limited, Windsor, Ont., as Catalogue No. 9. A wide assortment of tapes and their accessories, including hooks, tension handles, reels, arrows, as well as a large variety of steel and boxwood rules, yard-sticks, squares, etc., as required by engineers, contractors, surveyors, lumbermen, etc.

Motor-Driven Pumps.—Catalogue No. 3,002-A of the Canadian Westinghouse Co., Hamilton, Ont., describing in 24 pages the motors which that company manufactures for driving all types and sizes of pumps. The catalogue contains quite a supply of information on the requirements of pumps for sewage disposal systems, waterworks, mines, industrial plants, fire departments, irrigation work, dry-docks, contractors' use, etc.

Appliances for burning Fuel Oil.—A large, handsomely illustrated 32-page catalogue issued by the Tate, Jones and Co., Inc., Pittsburgh. It outlines the economy of oil for steam production; the advantages of oil fuel for furnaces; the importance of the burner to success with fuel oil, giving actual results in each case. The remainder of the catalogue describes the company's types of burners, and systems of pumping, heating and regulating oil flow.

BOARD OF HEALTH APPROVALS.

During the week of September 7th the Provincial Board of Health of Ontario approved of the sewer extensions of Arnprior, Kingston and New Liskeard. Water mains for the city of Toronto were also approved of.

Coast to Coast

Moncton, N.B.—The gates of Moncton's new 50-foot reservoir are now closed, according to the recent announcement of City Engineer Edington; and when it has been flushed sufficiently to remove all debris, a water supply will be turned on in the town. It is expected that the supply will be available in about two months' time.

Gagetown, N.B.—Finishing touches are being given to the rail-bed of the Valley Railway, which will connect Gagetown and Fredericton, and over which it is fully expected a service will be commenced this winter. Rails have been laid as far as the station, and the station building has been completed. The water tank at the station is not yet in working order. The well in connection with the tank has been dug to a depth of 200 feet; but this depth does not give sufficient depth for the flow of 40,000 gallons per day which is required.

St. John, N.B.—The Dominion Bridge Company has practically reassembled its construction plant at the eastern side of the river at the Falls. The trestle, which starts below the rock cut on the C.P.R. track and crosses over at the corner of Chesley Street to the approach of the bridge, has been finally connected; and the granite work on the skew-back piers on the east side are being finished by Messrs. J. McVey and Son. Within a few days, the Bridge company will be ready to swing out the steel on the eastern part of the arch to complete the bridge.

Saskatoon, Sask.—It is stated that in connection with the work on the large reinforced concrete bridge being erected at Saskatoon, the contractor has installed a pneumatic concrete mixing plant, a patented mixer, in which the mixing is done by compressed air and the concrete is transferred from the mixer to the point of disposal under air pressure. Also the difficulty which was experienced last winter in constructing the river pier third from the east abutment causing this work to be left unfinished, has been overcome; and now but one pier on the whole work remains to be undertaken.

Valcartier, Que.—Since the action of the Dominion Government making Valcartier on the C.N.R. the centre for the Canadian military camp, the railway company has constructed a main line, 8,800 feet long, from mileage 15.05 to a point on the Gosford branch of the system. On this line, 3 sidings have been laid as the main transfer point: one of these is double-ended, the other two entering only from the west. Several additional sidings have also been built, and a 12-degree loop from the west end to the sidings is connected with the Gosford line in the return direction. The engineering work for this new terminal was supervised by Mr. C. H. N. Connell, engineer of maintenance of way on the C.N.R.

Ottawa, Ont.—An announcement made at Ottawa at the beginning of this month stated that Canada has taken over the wireless stations at Port Nelson and The Pas. The stations were erected with government funds by the Marconi company, which had the contract to operate them for a year. The period for their operation by the Marconi company is expiring. It has been decided that the operation hereafter can be best carried on by the wireless branch of the naval service department. The two stations will form part of a wireless chain which the government proposes to provide for Hudson Bay. Both The Pas and Nelson stations are equipped with apparatus of high power. They have a despatching reach of 400 miles overland. Other stations will be erected further north. There will be one on Maunsel Island, at the western extremity of Hudson Strait, one at Ash Inlet, about the centre of the Strait, and one at Button Islands, at the Atlantic end of the Strait. When these stations are completed it will be possible to speedily convey and receive information over the whole Hudson region.

PERSONAL.

Col. W. P. ANDERSON, C.M.G., chief engineer of the Department of Marine and Fisheries, Ottawa, is in British Columbia on his annual inspection of the works under the control of that department.

D. L. H. FORBES, B.A.Sc., M.E., has been appointed chief construction engineer of the Chile Exploration Company of Chuquicamata, Chile. For some time Mr. Forbes had carried on a consulting mining engineering practice, with offices in Toronto.

Major E. C. NORSWORTHY was last week elected a director of the Canada Cement Company, Montreal. Major Norsworthy, who is at present with the Royal Scots Regiment at Valcartier, is a director of the Dominion Securities Corporation, and its manager for Montreal.

PERCY WILGER, formerly an engineer on the National Transcontinental Railway, has been appointed Professor of Civil Engineering, School of Mining, Queen's University, Kingston. Mr. Wilger is a Queen's graduate of 10 years' standing. He succeeds the late Professor A. K. Kirkpatrick.

E. S. CLEMENTS of the Canada Creosoting Co., Limited, Toronto and Trenton, Ont., has resigned.

OBITUARY.

The death is reported of Mr. Jas. A. Gould, Edmonton superintendent for the Bitulithic Paving Company. Seven years ago Mr. Gould resigned from a position as street superintendent of the City of Toronto to take a position in Edmonton for the above company. In 1910 he resigned to become superintendent of streets for Edmonton, but in 1913 he returned to the employ of the paving firm. Mr. Gould's death was quite sudden and unexpected, heart failure being the cause.

The death occurred last week of Mr. Fred. H. Herbert, a prominent architect of Toronto.

Our readers will no doubt remember the controversy which followed the disastrous storm of November 9th, 1913, and its heavy toll of life and traffic on the Great Lakes. *The Canadian Engineer* of December 11th, 1913, published some valuable suggestions as to the possible prevention of similar disasters to inland freighters from the pen of Mr. Wm. E. Redway, Naval Architect, Toronto. We regret at this time to be called upon to report the death of Mr. Redway, on September 19th, 1914. Since 1884 he had been associated with shipbuilding in Canada, during which period he designed many improvements, and received honored recognition from various naval organizations within and outside the Empire.

CORRECTION IN ADDRESS.

In the advertisement of the De Laval Steam Turbine Co. for several weeks past, the address of the Turbine Equipment Co., Limited, Toronto, who are the Canadian representatives of the De Laval Steam Turbine Co., has been given in error as 204 Peterkin Building. The correct address of the Turbine Equipment Co., Limited, is the Canadian Pacific Building, King and Yonge Streets, Toronto, to which they moved a few weeks ago from the Peterkin Building.

C.G.E. CORPS OF ENGINEERS.

In connection with the mustering of Canadian troops the Canadian General Electric Co. has established a corps of engineers, both electrical and mechanical, and has divided it into three sections to serve at Quebec, Halifax and Esquimalt. The company is maintaining six corps of technical men at its own cost throughout the duration of the war. Prior to taking their departure from Toronto for their respective posts of duty Mr. Frederic Nicholls, President of the General Electric Company, delivered a parting address to the men, exhorting them to be as consistent in the service which they are undertaking as they had been in the service of the company.

The personnel of the three detachments is as follows:—

For Quebec—Messrs. W. J. Swanger, R. W. Nurse, George Monaghan, George Hillier, C. Pink, P. Foster, H. Galvin, of Peterboro, and Colin C. Rous, of Toronto.

For Halifax—Messrs. H. S. McKean, J. C. Munro, Clarence Henry, E. S. Shill, R. Bethune, A. J. Palmer, of Peterboro, and F. G. Jackson, Edward Crockford, of Toronto.

For Esquimalt—Messrs. H. Ritchie, Chas. Stewart, H. E. Elliott, W. S. Johnson, H. Williams, J. S. Dunlop, of Peterboro, and A. T. McLean, Harold Bestard, Alex. Hardie, of Toronto.

COMING MEETINGS.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Seventh Annual Meeting to be held at Quebec, September 21st and 22nd, 1914. Hon. Secretary, Alcide Chausse, 5 Beaver Hall Square, Montreal.

MOTOR TRUCK CLUB OF AMERICA.—Annual Convention, Detroit, Mich., October 7th to 9th. President, George H. Duck, New York City.

GULF AND INTEROCEAN NATIONAL HIGHWAY ASSOCIATION.—October 8th, 9th, 10th; conference to be held at New Orleans, La. Secretary, Jno. B. Kent, Lake Charles, La.

INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS.—Annual Convention, Grunewald Hotel, New Orleans, La. October 20th to 23rd. Secretary, Mr. McFall, Roanoke, Va.

ALABAMA GOOD ROADS ASSOCIATION.—Nineteenth Annual Convention will be held from October 21st to 23rd at Montgomery, Ala. Secretary, J. A. Rountree, 1021 Brown Marx Building, Birmingham, Ala.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Charles Carroll Brown, Secretary, Indianapolis, Ind. Meets at Somerset Hotel, Boston, Mass., October 21st, 22nd and 23rd.

NORTHWESTERN ROAD CONGRESS.—Annual Convention, to be held at Milwaukee, Wis., October 28th to 31st. Secretary, J. P. Keenan, Milwaukee.

AMERICAN HIGHWAYS ASSOCIATION.—Fourth American Road Congress to be held in Atlanta, Ga., November 9th to 13th, 1914. I. S. Pennybacker, Executive Secretary, and Chas. P. Light, Business Manager, Colorado Building, Washington, D.C.

WASHINGTON STATE GOOD ROADS ASSOCIATION.—Convention to be held at Spokane, Wash., November 18th, 19th, and 20th. Secretary, M. D. Lechey, Alaska Building, Seattle, Wash.

ANNUAL MEETING, AMERICAN SOCIETY OF MECHANICAL ENGINEERS.—The annual meeting of the American Society of Mechanical Engineers will be held in New York, December 1st to 4th, 1914. Secretary, Calvin W. Rice, 29 West 39th Street, New York.