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The Canadian Engineer

A weekly paper for Canadian civil engineers and contractors

New Power House at Swift Rapids, Ont.

Power Development on Severn River—History of the Orillia Water, Light and Power Commission—Area of Water Shed to be Increased from 113 to 260 Acres—Government to Supply Power to Municipality During Period Necessary for Dismantling the Old Plant

IT was in 1887 that the town of Orillia made its first move in the direction of owning its public utilities, so far as electric power is concerned, although in 1883 the municipality purchased the waterworks plant which up to that time had been privately owned.

The power plant which the town erected in 1887 was designed primarily for street lighting. In 1894 the commission erected its first incandescent lighting plant. Both of these were steam plants and of very modest proportions, the arc plant having a capacity of 50 lamps and the incandescent plant of 15,000 lamps. The cost of the arc plant was $20,000 and of the incandescent plant $13,000, very modest sums in the light of present-day expenditures.

It was not until 1897 that the idea of developing water power on the Severn River was mooted, and in 1898 a business council was elected to undertake the project. After looking at various sites on the Severn River it was finally decided to locate the plant at Ragged Rapids and a contract for the construction of the Ragged Rapids plant was awarded in 1899. It was not, however, until the spring of 1902 that current was actually turned on. Since that time three different dams have been built and the plant capacity has been increased from 600 to 1,200 kilowatts.

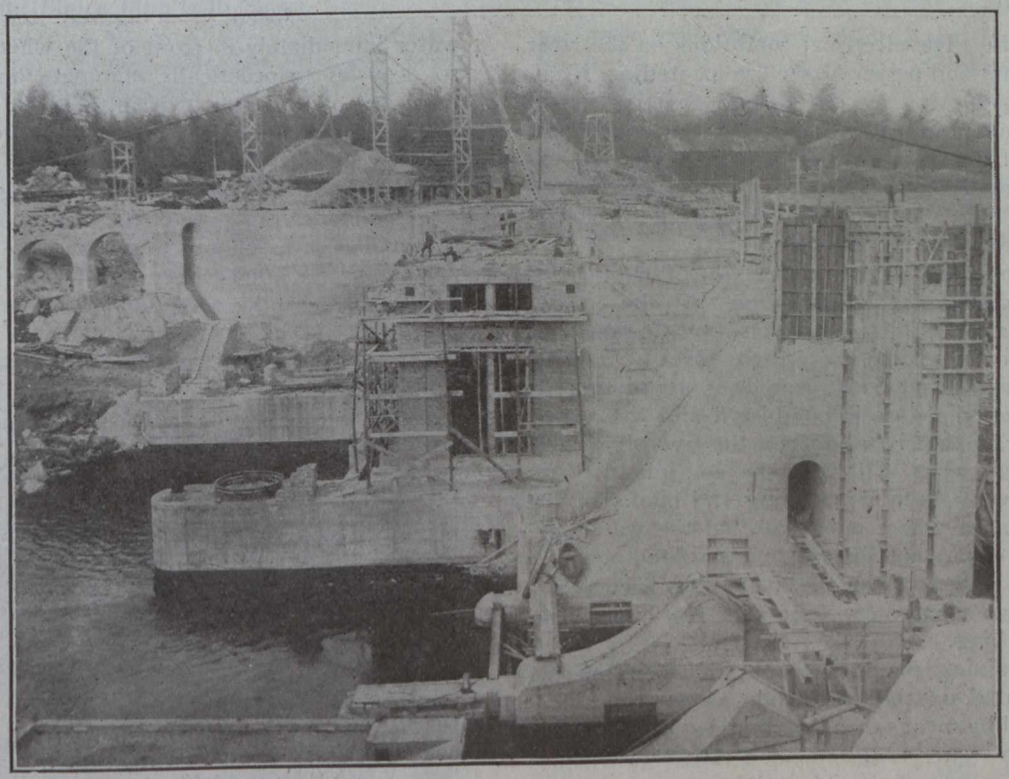


Fig. 1.—View from South Bank of River, Showing Complete Layout. Power House is Immediately Behind the Wheel-pit House

The Ragged Rapids plant of the Orillia Water, Light and Power Commission has been an important factor in Orillia's industrial life as well as in stimulating a public spirit among all classes of the community. As showing the growth of power necessary to supply the requirements of the municipality it may be mentioned that the modest anticipations of the early years have been more than realized, so much so that to-day Orillia is purchasing one and one-half times as much current as her own plant is producing, and even then it is difficult to meet the demand. Since the plant at Ragged Rapids was built it has always paid its way without making any demand upon the tax rate to meet deficits and has supplied the town with light and power at cheap rates.

The Severn River, upon which the new Swift Rapids plant described, and the Ragged Rapids plant are both located, forms a link in the Trent Valley Canal system, being section No. 2 of that work.

Several years ago engineers of the Department of Railways and Canals, in charge of the building of this section of the Trent Valley Canal, decided to place a lock at Swift Rapids instead of at Ragged Rapids. The reason for this was that it would be cheaper to do so rather than go to the expense necessary to the building of such a channel as it was found would be needed in order to enable the Trent Valley Canal to get past the existing plant at the Ragged Rapids.

The plant at Swift Rapids will, when completed, take the place of the Ragged Rapids plant. The cost of the construction of the new dam and power house is being borne by the Dominion government. The mechanical and electrical equipment of it, however, is to be paid for by the Orillia Water, Light and Power Commission. As a result of this arrangement between the commission and

the Department of Railways and Canals, Orillia will soon find herself equipped with a most modern power plant, having a capacity of 5,000 horse-power or 2,000 horse-power more than is being used at present, while the Dominion government will save a considerable sum of money. The arrangement is therefore mutually satisfactory to both parties.

The hydraulic conditions at Swift Rapids for power development purposes are very much more favorable than

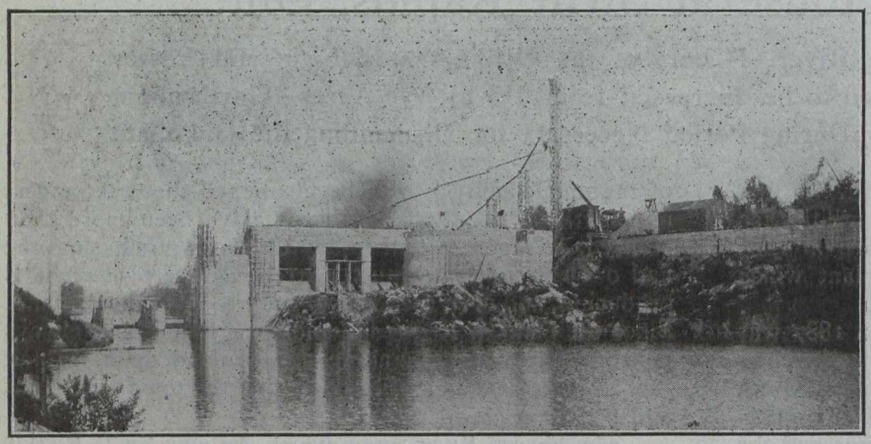


Fig. 2.—View Taken Looking Downstream, Showing Wheel-pit House, Entrance to Canal and Dam Partly Built

at Ragged Rapids. The electrical conditions on the river where the new dam and power house are located are ideal, and those responsible for the design and construction of the plant have taken full advantage of these conditions, as will be seen from Figs. 1 and 2, which give an excellent idea of the layout. The river at this point is approximately 110 feet wide and the geological formation lends itself admirably to the design.

The contractors for section 2 of the Trent Valley Canal, which includes the construction of the power house and dam, are the Inland Construction Company of Toronto. The distance from the present plant at Ragged Rapids to the new one at Swift Rapids is approximately two miles. When the dam is completed and the valves closed, the water in the river between the two plants will back up and form what will really be an inland lake. Clearing has already been done along the banks of the river up to the point where it is expected the water will back. In order to prevent the water from flooding some ravine land lying to the west of the river it has been necessary to put in two wing dams, one 420 feet long and another 200 feet long.

The central mixing plant of the Inland Construction Company is located on the north side of the river and concrete is placed by means of a distributing tower, shown in Fig. 1, which is 155 feet high, the concrete from which is carried to various parts of the job in Ransome conveyers.

There are three sluice valves, each 72 inches diameter and are operated by winches, as shown in Fig. 5. These are arranged for electrical operation although the electrical apparatus is not being installed at the present time.

The sluice pipes are 40 feet long, 10 feet in diameter at the wide end looking down-stream, and 6 feet diameter at the valve end. They are built of 5/8-inch steel plate. The sluice pipes, valves and operating machinery were made by Wm. Hamilton Co., Limited, Peterborough, Ontario.

In launching the sluice pipes, each of which weigh 17 tons, the method employed was as follows: Double bulkheads were placed at each end; three trees of fairly large size were slipped into the water, the root end of the trees being placed on the edge of the dock; the sluices were then simply pushed over the side of the dock, the trees helping to break the fall. After launching, they were one-third submerged and were then towed to position below the dam. Stop-logs were then placed at each end of the sluice chamber and the chamber pumped out, as shown in Fig. 4, and kept pumped out while connection was made with the sluice valves. At the time notes for this article were being secured two of the sluice pipes had already been placed in position. The river was passing through these two sluices and the water level in the river above the dam was only two feet above normal, so that when the three pipes are in position there will be no trouble controlling the river. The dam is approximately 110 feet wide and will have, when completed, five spillways, each 20 feet wide. The concrete work of the dam, wheel house, etc., is of excellent character, very strong and well finished.

The power house, which is behind the wheel-pit house, is built of buff brick with green glazed brick trimming. The interior floor of the power house will be laid with 6-inch red tile and black mortar pointing. When the dam is completed, and the valves closed, it is figured that the depth of the water immediately in front of the wheel-pit house will be so deep as to practically eliminate any possible trouble from ice. The water level in the river when flooded back will be about three feet above the apron, shown in Fig. 3. The head at the new power house will be 47 feet, or 12 feet more than at the present Ragged Rapids plant.

The flow at this time of the year is about 1,200 second-feet and it is estimated that when the dam is completed and the power house ready for operation it will take about a week to back the water up to the new level.

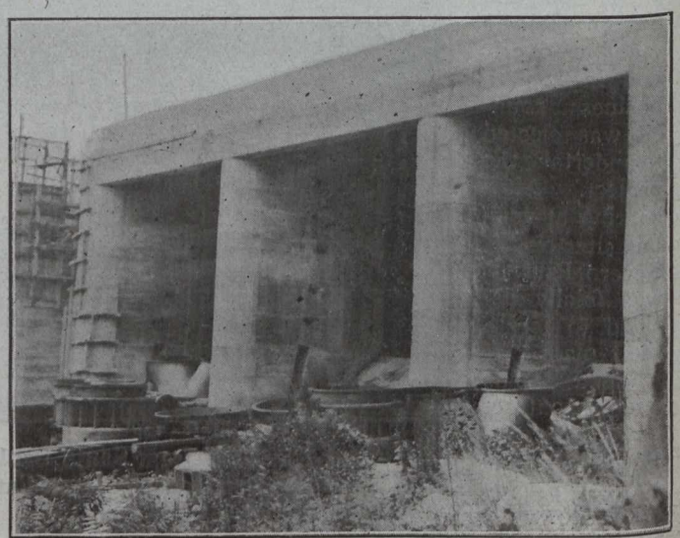


Fig. 3.—Upstream Side of Wheelpit House; Wheel Parts in Foreground Ready to be Assembled

The electrical equipment contract was awarded to the Canadian General Electric Company.

The power house is furnished with a 20-ton crane, built by the Herbert Morris Crane and Hoist Company, of Toronto. It has a span of 27 feet 3 inches and runs the entire length of the power house.

The hydraulic machinery was supplied by the Boving Hydraulic and Engineering Company, Limited, of Lindsay, Ont., details of which follow: The generator turbines are of the twin horizontal type set in open flumes on concrete draft tubes; each turbine is capable of developing 2,250 b.h.p. under a 45-ft. head when running

Fig. 4.—Pumping Out Sluice Pipe Chamber Preparatory to Connecting Sluice Pipe with Sluice Valves

at 257 revolutions per minute. They are of special heavy type with movable guide vanes of cast steel which are pivotted in bronze bearings and connected to the regulating rings by bronzed bushed links. The regulating rings are provided with rollers which reduce the friction resistance considerably and eliminate a great deal of wear.

The runners are of the latest high-efficiency type, made of steel like the guide vanes. They are mounted on a 9½-inch shaft which is supported in two heavy-ring lubricated bearings of which the rear one is a marine thrust bearing accessible through an inspection tunnel which runs under the head race.

This shaft is also supported in the centre by lignum vitae bearing adjustable from the outside.

The governors are of the latest oil-pressure type, direct connected to the gate shafts, and calculated to keep the regulation within very close limits.

The exciter turbine is of the single horizontal enclosed type designed to develop 150 b.h.p. when running at 700 revolutions per minute. It is fed through a 30-inch steel penstock and can be shut off by means of a 30-inch butterfly valve mounted near the wall of the power house. The bedplate is extended to carry the direct-connected dynamo, making a very compact unit.

The exciter turbine is also fitted with an automatic oil-pressure governor and a 5-foot flywheel in order to insure close regulation.

So as not to cause any inconvenience to the power users of Orillia during the period of changing over from one plant to the other, the Orillia Water, Light and Power Commission and the Department of Railways and Canals are to agree on a certain date, a month from which the old plant is to be dismantled, machinery taken out, and the old dam removed. During the interval, which may be a month or perhaps less, the government has guaranteed to supply Orillia with necessary power.

Since 1913 both waterworks and electric power plant in Orillia have been in charge of the commission. The five members of the present commission are J. B. Tudhope, J. T. Horne, R. J. Sanderson, C. H. Hale, chairman, with the mayor ex-officio. W. K. Greenwood, A.M.Can.Soc.C.E., is chief engineer for the commission, while James Mackintosh, A.M.Can.Soc.C.E., is resident engineer on the work for the Department of Railways and Canals.

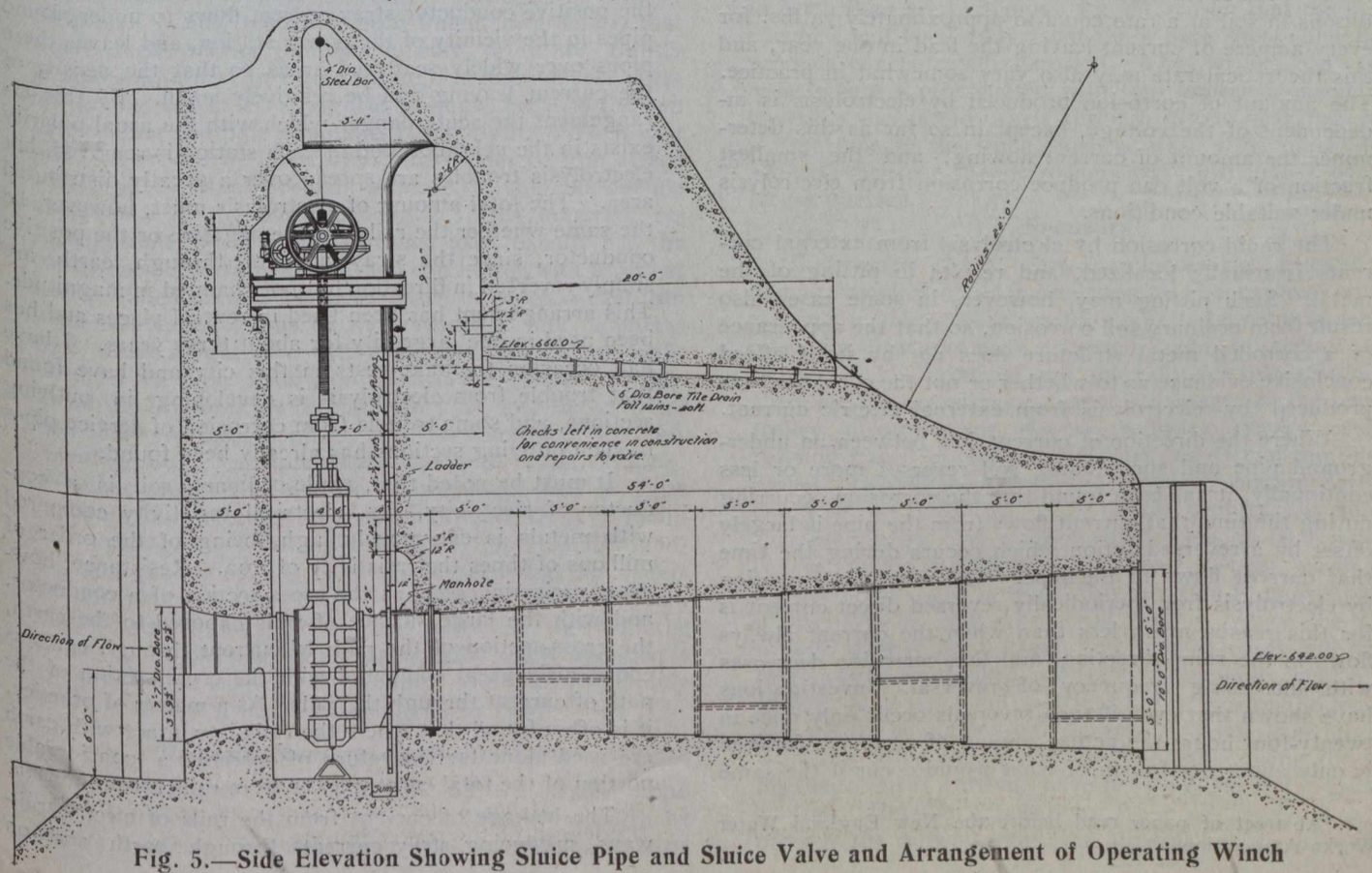


Fig. 5.—Side Elevation Showing Sluice Pipe and Sluice Valve and Arrangement of Operating Winch

ELECTROLYSIS—TROUBLES CAUSED THEREBY AND REMEDIES WHICH MAY BE APPLIED*

By Albert F. Ganz

Professor Electrical Engineering, Stevens Institute of Technology, Castle Point, Hoboken, N.J.

ELECTROLYSIS is the process of decomposing a chemical compound by means of an electric current. Electrolysis, in the sense in which it will be discussed here and in which you are particularly interested, refers to the corrosion of underground metallic structures, such as iron and lead pipes, by stray electric currents which reach these structures and flow to surrounding soil. Soil, when entirely dry, practically does not conduct electric current. Pure water likewise has such a high electrical resistance, compared with iron or lead, that it may be considered a non-conductor. Water is, however, readily made conducting by the addition of even very small amounts of salts, and conduction through water is therefore always electrolytic. Soil in its natural state is always moist, and on account of dissolved salts, such as chlorides, nitrates, etc., which are always present, is an electrolytic conductor.

The mass of metal corroded by electrolysis in a given time depends only on the "current," and, with the current densities and other conditions usually found in the case of underground pipes, is equal to that calculated by Faraday's law. Iron is oxidized by electrolysis at the rate of approximately 20 lbs. per year for every ampere of current flowing from the iron to surrounding soil. Under some conditions, particularly with very small current densities, this corrosion may be considerably greater, while with larger current densities than the above, this corrosion may be considerably less than the theoretical rate. The actual rate may vary in practice from one-half to one and one-half times the theoretical rate. Lead is oxidized by electrolysis under ordinary conditions in soil at a rate equal to approximately 74 lbs. for every ampere of current leaving the lead in one year, and this theoretical rate may also vary somewhat in practice. The amount of corrosion produced by electrolysis is independent of the voltage, except in so far as this determines the amount of current flowing, and the smallest fraction of a volt can produce corrosion from electrolysis under suitable conditions.

The rapid corrosion by electrolysis from external currents is usually localized, and results in pitting of the metal. Such pitting may, however, in some cases also result from ordinary soil corrosion, so that the appearance of a corroded metal structure does not by itself afford conclusive evidence as to whether or not the corrosion was produced by electrolysis from external electric current.

Where the direction of current flow between an underground pipe and surrounding soil reverses more or less continually, it has been found that the corrosion occurring during the time that current flows from the pipe is largely offset by a reversed action which occurs during the time that current flows to the pipe. The resultant corrosion by electrolysis from periodically reversed direct current is for this reason much less than when the current always flows in the same direction, and this corrosion decreases with increasing frequency of reversal. Investigations have shown that even if such reversals occur only once in twenty-four hours the actual amount of corrosion for iron is only about one-fourth of what would occur if the same amount of current always flowed from the pipe to surrounding soil.

*Abstract of paper read before the New England Water Works Association.

Sources of Stray Currents which May Produce Electrolysis

Electrical distribution systems which are grounded at two or more points will, by the law of divided circuits, cause currents called "stray currents" to shunt through the earth between the grounded points, and these stray currents frequently reach underground metallic structures and corrode them by electrolysis. In practice, it is found that the most important sources of stray electric currents, which so endanger underground structures, are direct-current electric railways, which use the running tracks in contact with ground for part of the electric circuit.

For such railways, it is the common practice to supply current to the cars from an overhead trolley wire or from a third rail, and to return this current to the power station through the running tracks, supplemented in large systems by return feeders.

In the simplest form of single-trolley railway the rails are connected to the negative terminal of the generator at the power station, and the only path for current to return to the power station is by way of the running tracks. If the running tracks are laid upon wooden ties above ground with broken stone for road ballast, as is common on steam railroads which run on their own right-of-way, the rails do not come in direct contact with ground, and the return current will be practically confined to the running tracks. If, however, the running tracks are laid below ground so that the top of the rails is level with the surface of the street, as is common in cities, then the rails will be exposed for a considerable area to contact with ground. If the tracks are laid on a concrete base, a considerable area of the rails will similarly be in contact with the concrete.

It has been suggested to reverse the usual arrangement of trolley system and make the rails the positive conductor instead of the negative conductor. With the rails the positive conductor stray current flows to underground pipes in the vicinity of the power station, and leaves these pipes over widely scattered areas so that the density of the current leaving will be relatively small. By this arrangement the acute danger which with the usual polarity exists in the neighborhood of each station is removed, but electrolysis troubles are spread over a greatly distributed area. The total amount of electrolysis must, however, be the same whether the rails are the negative or the positive conductor, since the stray currents through earth are simply reversed in direction but not changed in magnitude. This arrangement has been tried in several places and has been used in one large city for about three years. I have had occasion to make tests in this city and have found that trouble from electrolysis is developing in outlying sections, and some trouble from corrosion of service pipes in such outlying sections has already been found.

It must be noted that, while ordinary soil is a conductor of electricity, its electrical resistivity compared with metals is enormously high, being of the order of millions of times the resistivity of iron. Resistance, however, varies inversely as the cross-section of a conductor, and with the large surface of rails exposed to the earth, the cross-section of the path of current through earth is enormously great compared with the cross-section of the path of current through the rails. As a matter of practice, it is often found that where the rails in contact with earth are used alone for the return of current, a considerable portion of the total current leaks from rails through earth.

The leakage of current from the rails of electric railways, producing stray currents through earth and on

underground piping, does not constitute a source of loss to the railway company, as, for instance, would be the case with leakage of gas or water. On the contrary, by allowing the current to return by earth and underground pipes as well as by way of the rails, the total conductivity of the return circuit is increased, and the voltage loss in the return of this current is decreased, so that there is an actual saving of power for the railway company.

Alternating currents have been used for some years past in a number of electric railways employing the running tracks as a part of the electric circuit, and where these tracks are in contact with earth, stray alternating currents through earth are produced. Where an alternating current flows from iron or lead to surrounding soil, corrosion from electrolysis may also be produced, but this proceeds at a relatively very slow rate, as already explained. With alternating currents, electrolysis is, however, produced at the two electrodes, instead of at one electrode only, as with direct current. So far as the writer is aware, no damage from electrolysis due to such stray alternating railway currents has been reported to this date. This may be due to the slow rate at which corrosion is produced by alternating currents, together with the fact that most of these railways are of relatively recent installation. It may also be due to the fact that stray direct currents are nearly always present with the alternating currents, and the effects of these direct currents may have inhibited or masked the effect of the alternating currents. It is therefore not possible at this time to draw a positive conclusion as to the danger from stray alternating currents.

Where current leaves a wrought-iron or steel pipe for earth, the oxide of iron resulting from electrolysis becomes diffused through the earth, and streaks of iron oxide can generally be found in the surrounding soil. Electrolysis of wrought-iron or steel pipes usually results in pits which eventually go entirely through the wall of the pipe. It has frequently been found, in practice, that where a gas service pipe lies in clay or other tightly packed soil, it may be pitted through in many places without giving any external sign of leakage, because the soil surrounding the pipe maintains it gas-tight. When cast iron is corroded by electrolysis, the oxides of iron mixed with graphite usually remain in place, leaving the outside appearance of the pipe unchanged. This material, resulting from the electrolysis of cast iron, usually has the consistency of hard graphite, and can be cut with a pocket knife. There have been many cases in which a cast-iron main was carrying gas or water without any apparent leak, where a light blow with a hammer drove a hole right through the pipe. Here the electrolytic action had corroded the iron entirely through the pipe, and the oxide of iron had remained in place, and, together with the surrounding soil, had prevented the pipe from leaking. Whether or not the mixture of iron oxide and graphite resulting from electrolysis remains in place so as to maintain a pipe gas or water-tight, depends upon the surrounding soil conditions. It is therefore seen that an underground piping system may be suffering severely from electrolysis without giving any outward sign of the damage. A physical examination with a test hammer is required in the case of cast-iron pipe to establish definitely whether or not it has been damaged by electrolysis.

Remedial Measures Applied to Pipes

Attempts have been made to protect underground pipes from electrolysis by insulating them from earth by paints or dips. Practical experience as well as a large number of tests have, however, shown that no dip or paint will permanently protect a pipe against electrolysis in wet soil. The first difficulty is to apply the paint so as to form an absolutely perfect coating, and the second one is to prevent mechanical damage to the coating during shipment and installation of the pipe. In the case of paints which are applied with a brush, these afford only a very thin coating over the metal, and where stray currents are present, the effect of these currents and of the moist soil is to cause the coating to disintegrate and disappear rapidly. A large number of experiments which I have made have shown that such paints will disintegrate not only where the current flow is from the metal to earth, but also where the flow is from earth to the metal. Experience further shows that even where coatings of paints or dips are apparently intact, electrolytic action is not always prevented, and, in fact, very serious electrolytic pittings have been found under apparently good coatings. It has been found that in most cases the applied coatings have either been completely destroyed by the effects of the wet soil and the electric currents, or defects in the coating have developed, causing concentrated corrosion at such defective spots. Where it is attempted to apply a heated material like pitch or asphaltum to a cold pipe, it is impossible to completely cover the pipe. Pitch and similar compounds have been applied to pipes with wrappings of jute or of some similar material. A number of layers can be applied in this way so as to build up any desired thickness of insulating covering. Such covering, if sufficiently thick, will afford protection against electrolysis, provided that it is mechanically perfect. The great difficulty in practice is to apply such a covering without leaving defective spots through which moisture will have access to the metal of the pipe.

Pipes which are covered with imperfect insulating coatings or coverings exposing bare spots of metal, are in much greater danger from electrolysis where positive to earth than are bare pipes, for the reason that the stray currents will leave only from these bare spots, and here produce concentrated corrosion. The writer has seen cases where a pipe coated with an imperfect insulating covering was pitted nearly through in one year, whereas a bare pipe in the same locality was very much less affected, because the corrosion was distributed over a larger surface.

Summary

Experience shows that an increasing amount of damage by electrolysis is occurring on underground piping systems in many localities throughout the country where adequate measures have not been taken to reduce this damage. The principal and generally the sole sources of stray electric currents causing this damage are the single-trolley direct-current electric railways employing the running tracks in contact with earth as part of the return circuit. Experience extending over many years in foreign countries and over ten years in this country has shown that practicable and economical methods of construction can be applied to such electric railway systems which will remove acute dangers from stray currents to underground piping systems and which will greatly reduce the electrolysis danger in all cases, and in most cases will make this danger negligible. Mitigating methods applied to underground pipes fail to attack the source of the trouble and should be applied only in special cases, if at all, and then only after adequate methods of minimizing the production of stray currents have been applied to the railway system. Metallic connections from underground water pipes to the railway return circuit which cause these pipes

to become a substantial part of this return circuit are inadequate for the protection of the pipes and are frequently dangerous. Such connections greatly increase current flow on pipes, and, while they may afford local protection, they generally distribute electrolysis troubles to other localities where they are more difficult to find, and in this way frequently give a false impression of immunity. Metallic connections from water pipes to the railway return circuit should generally not be permitted and in no case unless a careful study of conditions has shown that no serious danger will be produced. Such connections should never be applied to an underground piping system as the principal means of electrolysis mitigation.

In view of the fact that the railway companies in common with the pipe-owning companies are public utilities operating under public franchises and utilizing city streets, it is the duty of both of these utilities to co-operate in order that the causes and extent of any danger from stray currents can be more readily ascertained. Further, the satisfactory solution of the electrolysis problem is one which requires the co-operation of all of the interests concerned. I think that in the past the red flag has been waved too much, and some owners of underground properties have made unreasonable demands, with the result that the electric railway companies have been afraid to co-operate for fear that they would be asked to make excessive expenditures. There is no real reason for this. Electrolysis is an engineering problem, and can be handled by engineering methods in such a manner that no hardship need be imposed nor should be imposed on any one. There is no reason why the negative feeder system should not be laid out along the same engineering lines as the positive feeder system. I think that if the electric railway companies would realize this and the owners of underground properties would co-operate in a practical way, we could obtain a satisfactory and practical solution of the electrolysis problem. For instance, it often happens that the judicious installation of a few insulating joints will save a lot of money in railway track feeders, and in such cases such joints should be installed.

A most important step towards securing the co-operation, which is absolutely necessary in order to obtain adequate and permanent relief from electrolysis, has been made by the formation of the American Committee on Electrolysis. This committee includes representatives of the electric railway, water, gas, electric light, and telephone interests. This committee was organized in 1913 and has completed a preliminary report setting forth the facts regarding electrolysis, upon which the representatives of all of the varied interests have agreed. The committee has already accomplished a great deal towards producing a closer co-operation between the interests owning the electric railways and those owning the underground structures, and it is to be hoped that the future work of this committee will result in the unanimous adoption of recommendations which will reasonably safeguard underground piping systems against electrolysis.

The discovery of platinum in Alaska by Dr. Herschel C. Parker, of New York, and others, has aroused government agencies to the greatest activity in the hope of finding sufficient quantities of the metal to meet the war needs of the allies. Four government experts have been assigned to study the Alaskan situation and report if the discoveries may replenish the platinum supply cut off recently by the virtual cessation of activities in the Ural Mountain mines, the source of the world's greatest supply.

NOTES ON PREPARED PAINTS FOR METAL SURFACES.*

By Henry A. Gardner,
Assistant Director the Institution of Internal Research, Inc., Washington, D.C.

IN designing protective coatings for metal the modern practice has been to apply the results available from researches into the cause of corrosion. These results have shown that materials of a basic nature or substances which contain soluble chromates prevent the rusting of iron. For this reason pigments of a basic nature or pigments containing the chromate radical have come into wide use in the manufacture of protective paints. That they are the best pigments for this purpose has been proved not only in practice, but also in the Atlantic City tests, which were made upon a series of three hundred large steel panels, using nearly one hundred different pigment paints. Applying the results of these tests to the practical manufacture of protective coatings, the writer will discuss the use of the various pigments under separate headings, taking up the composition of the most widely used colors for metal painting, namely, red, gray, black and green. Most of the paints outlined herewith are suitable for the painting of structural steel, bridges, steel railroad cars and equipment, ornamental ironwork, poles, posts and for general work on metal surfaces.

Red Lead Priming Paints

Red lead may be purchased in the market ground to a heavy paste in linseed oil, ready to thin with oil for use. Such red lead is usually produced by the thorough oxidation or overburning of lead, the dry pigment generally containing approximately 98% of lead tetroxide. This pigment, being practically free from litharge, does not react to any great extent upon the linseed oil in which it is ground, and therefore remains soft for a considerable

Pigment Paints of Ten Highest Average Ratings, 1910-1914.

	1910.	1911.	1912.	1913.	1914.
Basic chromate of lead	9.1	10.0	9.9	9.8	7.5
Sublimed blue lead....	9.6	8.8	9.0	7.2	6.0
Carbon black and barytes	..	..	..	6.8	5.0
Chrome green	9.8	9.8	8.6	7.6	5.0
Willow charcoal	..	8.8	8.6	7.9	4.5
Red lead	..	..	8.1	..	4.0
Natural graphite, containing clay, etc....	..	..	..	..	4.0
Zinc chromate	9.4	9.5	8.8	8.0	4.0
Zinc-and-lead chromate	9.5	9.7	9.2	8.3	4.0
Magnetic black oxide..	9.5	9.5	8.6	7.8	4.0
Zinc-and-barium chromate	9.7	9.5	8.5	7.8	..
Sublimed white lead...	9.5	9.0	8.1	..	..
Bright red oxide	9.3	..	..	..	..
Prussian blue (water stim.)	9.2	..	..	6.7	..
Prussian blue (water inhib.)	..	8.5	..	..	..

*Bulletin of the Affiliated Engineering Societies of Minnesota.

period of time. It is well understood, however, that one of the most valuable properties of red lead is its ability to set up to a hard, elastic film that shuts out moisture and gases which are apt to cause corrosion. This cementing action is due to the presence of unburnt litharge, a pigment which rapidly reacts upon linseed oil to form a lead linoleate compound. It will readily be seen, therefore, that red lead free from litharge has no cementing action and should not be considered more protective than iron oxide or any other similar neutral pigment. It is thoroughly essential that red lead should be highly basic and should contain a considerable percentage of litharge, if the red lead is to protect iron from corrosion. Although such red lead is often purchased in the dry form and mixed with linseed oil on the job at the time of application, it is a growing custom to use prepared red-lead paints made from finely divided red lead ground to a fluid condition in linseed oil. Such paints remain in excellent condition for a long period of time. They have a high protective value and are well suited for general purposes. They are used extensively for priming steel vessels. The Navy Department has found that inert pigments, such as silica and asbestine, give good results when used in ready mixed red-lead paints, their action being to prevent settling of the red lead upon storage.

A specification which may be used by the grinder when purchasing dry red lead for the manufacture of prepared paints is given herewith:—

Specification

1. The dry pigment to be of the best quality, free from all adulterants, and to contain not less than 85% nor more than 90% Pb_3O_4, the remainder being practically pure lead monoxide (PbO).

2. It shall contain not more than 0.1% of metallic lead nor more than 0.1% of alkali figured as Na_2O.

3. It shall be of such fineness that not more than 0.5% remains after washing with water through a No. 21 silk bolting-cloth sieve.

Note.—If desired, the gram weight of the red lead may be specified. Extremely light, fluffy red lead should run from 10 to 13 grams per cubic inch. Medium red lead will run from 13 to 16 grams per cubic inch. Heavy red lead will run from 17 to 19 grams per cubic inch.

Composition of Red-Lead Priming Paints

The cost of red-lead paints is a subject of vital importance to the large user. Red lead may be produced in different physical states. Ordinarily the grade that has been overburned is extremely heavy, one cubic inch weighing from 18 to 20 grams. For the production of a paint from such red lead, according to the formula used by one large consumer, the following quantities would be required:—

Red lead	26 lbs.
Linseed oil	26 gills
Petroleum spirits	3 gills
Drier	3 gills

This would produce approximately 1 2/5 gals. of paint. Each gallon would contain about 20 lbs. of red lead, the actual cost of the red lead itself being in the neighborhood of $1.60. A red lead of a much better protective value, containing from 10% to 12% of free litharge and produced in an extremely fine physical state of comminution, so that one cubic inch would not weigh over 12 to 15 grams, would produce a paint of exactly the same body on the following formula:—

Red lead	20 lbs.
Raw linseed oil	26 gills
Turpentine	3 gills
Drier	3 gills

This would produce approximately 1⅓ gals. of paint, each gallon of which would contain about 15 lbs. of red lead, the actual cost of the dry pigment per gallon being in the neighborhood of $1.20. Red lead of still lighter gram weight could be used, so that a still smaller quantity of pigment would be required per gallon of oil. The durability of such paints should compare favorably with those containing very high percentages of red lead of high gram weight. Pigments of an extremely light nature, such as lampblack, grind in very large quantities of oil, yet their films are more elastic and durable than many paints which are composed of much pigment and little oil.

Red Paints

Iron oxide has always been one of the most widely used pigments for the manufacture of protective coatings. Oxides that are free from acid or soluble substances give the best results. There are many grades, from the brilliant Indian reds, containing 98%, down to the natural mined brown shale oxides, containing from 30 to 60% of ferric oxide, the balance being silica, clay, etc. Venetian reds, consisting of about equal parts of ferric oxide and calcium sulphate, are also quite widely used. It is customary to add to iron oxides from 10 to 20% of zinc chromate, zinc oxide, or red lead, in order to make them rust inhibitive. Such red paints are widely used for application to tin roofs, metal siding, and general structural steel. Red paints made from basic lead chromate (American vermilion), the pigment which gave the best results in the Atlantic City tests, would doubtless be the most economical in the long run, but the high cost will probably prevent their use to any great extent. The use of a percentage of basic chromate of lead in iron-oxide paints is to be approved.

Gray Paints

Mixtures of white lead (basic carbonate or basic sulphate) and zinc oxide, tinted gray with carbon black, are widely used for this purpose and give excellent results in every climate.

A valuable rust-inhibitive coating for general priming or finishing work may be prepared from sublimed blue lead. The use of two parts of blue lead and one part of linseed oil containing about 5% of turpentine drier makes a paint of the right consistency. This may be purchased in prepared form. When this paint is used for top-coat work in marine exposures (battleship gray), the addition of 1% of carbon black to the blue lead aids in the maintenance of the color. The rust-inhibitive value of this pigment is due to the high percentage of lead oxide (litharge). This pigment, however, is so combined with the lead sulphide that it does not have any great hardening action upon the linseed oil and stays in an excellent condition in paste form for a long period of time without hardening. When purchased ground to a paste in 10 parts of oil, there should be added approximately 5 gallons of linseed oil and one pint of drier for use. A specification for the purchase of blue lead for use in metallic paints is given herewith:—

	Minimum.	Maximum.
Lead sulphate	44%	52%
Lead oxide	33%	40%
Lead sulphide		0.5%
Lead sulphite		3.5%
Zinc oxide		3.0%

Black Paints

Black paints are often preferred for the finishing coat on steel work, carbonaceous paints being unsuited for application direct to the metal on account of their rust-stimulative action. Carbon pigments, such as gas carbon black, oil black, artificial and natural graphite (flake and amorphous) are usually the base pigments used in black paints. Silica and other earth pigments may be combined with the carbon. The slow-drying nature of such paints is lessened by the addition of litharge. The use of boiled linseed oil as a vehicle is advisable.

Magnetic black oxide of iron (precipitated) forms an excellent black protective paint when ground in linseed oil. The slightly basic character of this pigment accounts for its inhibitive value. The natural variety of black magnetic oxide of iron is also suitable for this purpose, but should be tested for freedom from soluble acid impurities before use. Willow charcoal is not made in commercial quantity; its use, therefore, will be restricted. Its inhibitive value depends upon the basic nature of the impurities present.

Green Paints

Mixtures of zinc chromate and Prussian blue in oil are highly inhibitive and have proved satisfactory in long service tests. Chrome yellow tinted with black oxide of iron to an olive shade is very permanent and protective. Chrome green made from lead chromate and Prussian blue is generally used when precipitated upon a barytes base.

Marine Paints

Steel vessels traversing bodies of salt water are rapidly acted upon, corrosion and incrustation by marine growths being shown. The bottoms of boats are usually protected by applying over the red-lead priming paint a coat of anti-corrosive paint containing iron and zinc pigments ground in a shellac-alcohol vehicle. There is subsequently applied a coat of anti-fouling paint, usually made of iron oxide, zinc oxide, and metallic zinc powder, admixed with a poisonous compound such as red oxide of mercury or bichloride of mercury. The upper portions of vessels are usually painted with a linseed-oil paint, the standard slate color of the Navy Department consisting of a mixture of white lead and zinc oxide tinted gray and ground in linseed oil. This is, of course, applied over a prime coating of prepared red lead. The boot topping or water-line paint is generally of a bituminous nature, the exposure at this point being extremely severe. Chinese wood-oil varnish improves the bitumen base.

Bituminous Paints

Bituminous coatings have a wide use for special purposes. They are often made by blending refined coal-tar pitch, asphalt, linseed oil and oleo-resinous varnishes, subsequently thinning down wtih turpentine or light mineral thinner. During recent years a heavy-bodied blown petroleum residual pitch has come into wide use in the manufacture of waterproofing bituminous paints. This pitch usually has a light melting point (150° C.). It is soluble in turpentine, benzol, and some mineral distillates. When in solution it may be admixed with oils for the production of rapid-drying elastic paints. The pitch has high resistance to acids and is not acted upon by the sun to the extent that coal tar is.

When coal tar is used in the manufacture of paints, it should be refined. Ammonia and water in the tar are the active causes of saponification or non-adherence to metal. The presence of large quantities of free carbon or naphthalene in the tar will cause disintegration and checking. For refining, the crude tar may be heated to approximately 115° C., holding it at that temperature until the water is evaporated. From 5 to 10% of lime may be stirred in, in order to neutralize the free acids. The tar may then be thinned with benzol or mineral spirits. If a rapid-drying paint is desired, a quantity of resinous varnish may be added. The addition of Chinese wood oil and asbestine in a coal-tar paint made along the above lines will aid in producing a film that is not so subject to alligatoring when exposed to the sun.

Bituminous paints of the above composition are used as coatings upon pipe-lines in acid factories, tanks containing dilute acids, metal submerged in water, and for other similar work. For such purposes it is generally advisable to first coat the metal with a thoroughly hard drying prime coating made by adding 2 lbs. of litharge to a prepared red lead or other rust-inhibitive paint. The bituminous paint may then be applied. Steel mine timbers subjected to sulphur water and gas, reservoir tanks containing water, submerged lock gates, tunnel metal, etc., may be efficiently preserved from corrosion by this method.

Painting Galvanized Iron

Roofing, siding, railing, drain pipes, cornice work, etc., constructed of galvanized iron require painting if they are to be kept in a good state of preservation. Paints are apt to peel from galvanized iron on account of the smooth spangled surface. This condition, however, is obviated by first treating the metal before painting with a solution of copper salts. Such a solution may be prepared by dissolving 4 ozs. of copper acetate, copper chloride, or copper sulphate in one gallon of water. By brushing on this solution the galvanized iron is roughened, a thin deposit of copper being plated out over the surface. After an hour or so, the surface may be lightly brushed and then painted with a thoroughly inhibitive oil paint. Firmly adhering films are thus produced.*

Painting Tinned Surfaces

Tin plate, such as is used for roofing and siding, will rapidly corrode unless protected by paint. The pin-holes present in the tin coating on the steel base metal act as pockets to catch moisture, which causes rust spots and pit-holes. Before applying paint to the sheets it is advisable to rub the surface of the tin with a cotton rag saturated with benzine or turpentine. This will remove the palm oil that is present upon the surface and allow the paint to firmly adhere. Iron-oxide paints containing an inhibitive pigment are widely used for preserving tin. The use of 15 to 20% of zinc oxide, red lead, or zinc chromate with a neutral bright iron oxide produces an excellent paint. The partial use of boiled linseed oil or kauri gum mixing varnish will add to the gloss and water resistance. Such paints are also suited for use on metal shingles and pressed-steel siding—plain black, galvanized, or tinned. For dipping purposes, turpentine or high boiling point mineral spirits should be used for thinning. Cheap driers containing a low boiling point benzine should be avoided.

*The writer has recently experimented with solutions of metallic salts of arsenic, antimony, tin, lead, mercury, cobalt, iron and manganese to replace copper solutions for the above purpose. Arsenic and tin were most satisfactory, but not as economical or desirable as copper.

Telephone lines are to be extended to Tromsoe, Norway, 200 miles north of the Arctic circle.

ONTARIO'S METALLIFEROUS PRODUCTION

RETURNS received by the Ontario Bureau of mines from the smelters, refining works and metalliferous mines of the province for the six months ended June 30th, 1917, are summarized in the table below which gives comparative figures for the corresponding period in 1916.

Hargrave mine is now shipping regularly. A new shipper this year is the National, formerly the King Edward mine. The Mining Corporation of Canada (Cobalt Lake and Townsite City mines) shipped over 2,000,000 ounces in the half-year. Shippers of 500,000 ounces or more were as follows: Nipissing, Kerr Lake, O'Brien, Beaver and Coniagas mines. Silver recovered from gold ores totalled 38,492 ounces and from copper ores 646 ounces.

Summary of Metalliferous Production, Six Months, 1917.

Product.		— Quantity — 1916.	1917.	— Value — 1916.	1917.
Gold	ounces	235,060	228,673	$ 4,822,740	$ 4,586,941
Silver	ounces	10,267,743	10,073,787	6,188,269	7,584,439
Cobalt (metallic)	lbs.	121,817	162,250	103,677	237,004
Nickel (metallic)	lbs.	13,933	45,864	5,899	19,073
			5,495		1,648
Nickel oxide	lbs.		153,498		175,308
Cobalt oxide	lbs.	410,408		204,638	
Other cobalt and nickel compounds	lbs.		122,076		15,879
Molybdenite	lbs.	12,631	36,777	13,075	47,942
Lead	lbs.	.....	912,934	.....	114,953
Copper ore	tons	922	1,543	14,368	45,688
Nickel in matte	tons	20,651	20,230	10,325,766	10,115,000
Copper in matte	tons	11,426	10,381	4,207,620	4,152,400
Iron ore (exported)	tons	.....	24,332	.....	85,135
Pig iron	tons	.....	40,968	.....	715,912
				$25,886,052	$27,897,322

It will be noted that above figures are for pig iron produced from Ontario ore only. Export figures for 1916 are not available for iron ore. Nickel and copper in matte have been valued at 25 and 20 cents per pound, respectively, whereas copper was valued at 18½ cents per pound in 1916.

Gold.

It was anticipated that the production for the half-year would show a decline as compared with the same period in 1916, owing to labor troubles and labor shortage at the Porcupine camp. Nearly all the mines, including the Hollinger and Dome, have been developing their ore bodies and increasing milling capacity in preparation for the time after the war when labor will be more plentiful and operating costs decreased. In the meantime, production and dividends have been curtailed. New producers are Gold Reef and Tommy Burns at Porcupine, Teck-Hughes at Kirkland Lake, and Miller-Independence at Boston Creek. A single stamp is dropping at the Rognon on Wabigoon Lake, District of Kenora. Mines, in order, producing 5,000 ounces or more gold were Hollinger, McIntyre, Dome, Porcupine Crown, Tough-Oakes, Schumacher and Porcupine V.N.T.

Silver

High prices for silver, which averaged 75.44 cents for the half-year as compared with 62.53 cents for the same period in 1916, have stimulated production from the Cobalt camp. The lowest New York price was 71.75 cents on March 27th and highest 78.64 on February 15th. This advance in value has offset increased mining costs. If the Miller-Lake O'Brien continues shipping at the same rate throughout the year, Gowganda will show a record production for 1917. The increase is attributed to the high-grade vein discovered in the summer of 1916. The

Nickel-Copper

The production of nickel-copper matte at Copper Cliff and Coniston shows a small decrease as compared with the same period in 1916, due to shortage of labor. Assays of samples of nickel-copper matte for their precious metal contents were made for the Royal Ontario Nickel Commission by Ledoux & Company, of New York. Platinum and palladium were found in quantities varying from 0.32 ounces to 1.97 ounces per ton of matte. These metals are quoted at $100 per ounce. The British America Nickel Corporation has announced that their new electrolytic refinery will be located at Murray Mine, and will have an initial capacity of 5,000 tons of nickel per annum. The Port Colborne refinery of the International Nickel Company will produce 7,500 tons of nickel, and provision is made for quadrupling the capacity.

Copper

Shipments for the half-year came from three sources, the Tip Top mine near Kashbowie, the Hudson Copper Company at Havilah, and the Kenyon Copper Company, of Massey. The last mentioned operates the Massey mine, where a 100-ton Callow flotation mill is producing 20 per cent. concentrates. Shipments from Bruce Mines are included under nickel-copper. The Port Arthur Copper Company at Mine Centre is erecting a concentrator and will be shipping soon.

Iron Ore and Pig Iron

Shipments of ore were from the Helen and Magpie mines of the Algoma Steel Corporation, and a small shipment from Moose Mountain. Helen ore is shipped to the Magpie mine for treatment. In all, 61,796 tons worth $231,937 were marketed, of which 24,322 tons were exported to the United States. Pig iron produced at Sault

Ste. Marie, Hamilton, Port Colborne and Deseronto totalled 347,190 tons worth $6,067,050. Out of a total of 577,773 tons of ore smelted only 77,202 tons came from Ontario, and in the table the quantity of pig iron produced and value of the same is figured on a pro rata basis.

Molybdenite

The production of this ore is increasing rapidly. Concentrators are now in operation at Renfrew, Mt. St. Patrick and Ottawa, and in the half-year treated ore from thirteen different mines. At Orillia and Belleville 80,334 pounds of ferro-molybdenum worth $200,835 were produced.

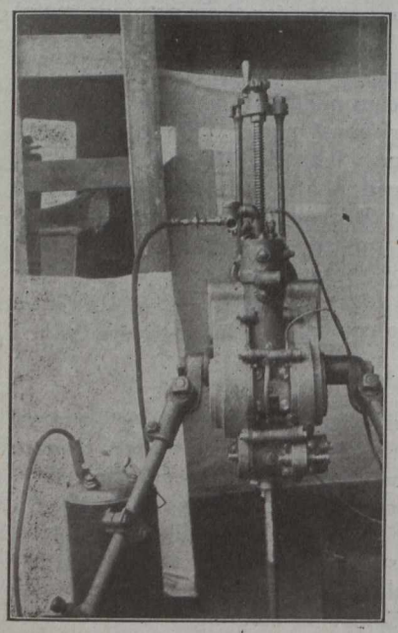
Lead

Smelters at Galetta and Kingston produced 912,934 pounds of pig lead, worth $114,953, from Ontario ores. The Kingston Smelting Company also treated 1,895 tons of lead ore from the United States. Ontario ore came from Galetta and Frontenac mines.

NEW GASOLINE ROCK DRILL

A NEW design of gasoline-driven rock drill has been developed by L. L. Scott, of St. Louis, Mo. The drill operates on the hammer principle. Hollow hexagon drill steel is used and the water for cooling the engine is run through the hollow steel to the bottom of the drill hole. About 800 blows per minute are struck.

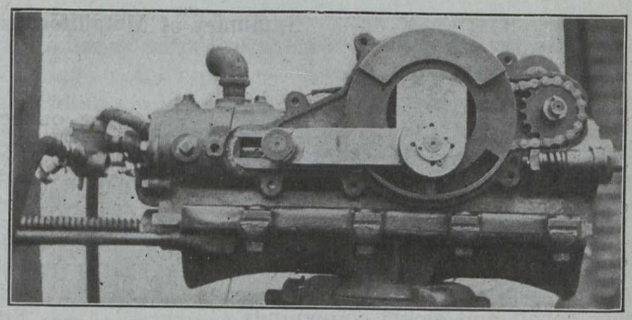
The engine is a simple single-cylinder two-cycle unit and is free from valves, gears and cams. The hammer is moved directly by explosive pressure and strikes a free blow. There are two pistons, one contained within the other. The outside piston is the hammer and has no mechanical connection with the inside piston, which latter is connected to the crankshaft through connecting rods. An explosion takes place with every down stroke, driving the two pistons downward. The hammer piston strikes its blow on a tappet at about 60° before the crankshaft has reached its lower dead centre; the inside piston moves on (independent of the hammer piston) with the crankshaft. This inner piston uncovers air ports in the hammer piston and on the back stroke (caused by the momentum of the flywheels) the hammer is picked up on a cushion of air.



Scott Gasoline Rock Drill.

The drill steel is rotated step by step by a special "compound" gear—no ratchets being used to get intermittent rotation. A standard double-thread worm is cut in half, and adjacent threads are connected by a straight no-pitch thread. The worm wheel is standard, with the exception that one side of each tooth is cut straight. The compound worm is driven by means of a chain and sprockets from the crankshaft. The worm wheel which is attached to the chuck rotates during one-half revolution of the worm and is stationary during one-half revolution. The rotation of the drill steel takes place only on the up stroke of the hammer.

While various sizes of this new drill have been experimented with for the past five years, only one size has been commercially developed; this drills holes up to 12 ft. in depth, and weighs 200 lbs. Gasoline is supplied from a small steel pressure tank—a pressure of 2 lbs. is pumped up by hand twice per day. Electric ignition is used.



Gasoline Rock Drill Has Double Piston

At the Glenco Lime and Cement Co., St. Louis, one of these drills has drilled 68 ft. in a 9-hour day, using two gallons of gasoline and one-quarter pint of cylinder oil. The rock was hard limestone. Tests of the drills have also been made at the Union Quarry and by the Fruin-Bambrick Construction Co., both of St. Louis. Mr. Scott stated last week that he was just sending a drill to a lead mine at St. Clair, Mo., to operate on a column in a tunnel, the exhaust to be piped out of the tunnel.

CORRECTION

On page 185 of our issue of August 30th, in L. N. Edwards' article on "Sands and Consistency of Concrete," the illustrations were accidentally transposed into wrong positions on the page. What was called the "upper side" of Fig. 34 should have been the illustration for Fig. 32. What was called Fig. 32 was a portion of Fig. 33, showing the best condition found with that consistency, while the photo which was correctly called Fig. 33 showed the worst condition found with that consistency. The words "(b) under side" should not have appeared with Fig. 34 as it is a vertical section showing both upper and under sides. Readers who bind their papers are requested to make note of these corrections on that page.

During the year ended June 30th, 1916, 5,149,289 train miles were run on the government railways of Western Australia, this being 255,525 miles less than during the previous year. The gross earnings were £2,088,100—an increase of £29,866. The working expenses amounted to £1,511,655, this being an increase of £13,829.

The Board of Control, Montreal, upon suggestion of Controller Villeneuve, have asked the city engineer for an estimate of the expense that would be entailed in making copies of all the city's plans. The plans, said the controller, are worth a considerable sum, and he considered that there should be copies so as to prevent irreparable loss by fire or theft.

PROBLEMS IN WASTE DISPOSAL*

By Henry A. Allen, Chicago, Ill.

THOUGH the questions of disposal of wastes have been under consideration for many years, it is comparatively recently that such have been submitted to careful engineering study and analysis.

The main factors to be considered in the disposal of municipal wastes are sanitation and discommodity—the first as affecting the health of the individual and of the general public, the second as affecting the individual or public in the matters of inconvenience, unsightliness and offensiveness.

In designing for a municipality, it is my opinion that the work should proceed along the following general divisions stated in the order of their importance:—

Factors to be Considered in Waste Disposal

Service.—Service requires that the apparatus and structures shall at all times be able to perform the duties imposed. In the case of waste disposal it means at all times required ability to collect, transport and dispose of in a convenient and sanitary manner all wastes produced.

Discommodity.—Discommodity or inconvenience relates to handling in a manner least disagreeable to, and entailing minimum effort on the part of, the individual or public.

Attractiveness.—Attractiveness in structures is desirable as its tendency is to make less acute any actual or imaginary odium attached to a plant, whereas neglect tends to magnify such.

Economy of Operation.—Economy of operation refers to the accomplishment of the work required in a most direct and inexpensive manner, having in view the obtaining of the greatest net monetary returns compatible with good sanitary and inoffensive operation.

Cost.—This factor is put last because it is assumed that any legislative body, appreciating the necessity of a function, will provide funds for the actuation of that function.

Often conveniences are demanded by individuals or the public, in utter disregard of the fact that such can not be had without commensurate expenditure of funds.

Economy in public works does not mean the apparent saving in moneys by the non-execution of a desired or required public improvement (so to speak, municipal deferred maintenance), but making each dollar appropriated go farthest in the execution of a necessary or desired public improvement.

Obviously, it is to the engineering professions that the public must turn if it is desired to have solved, in a logical and practical manner, the various intricate problems of municipal waste disposal.

Selection of a Garbage-Collection Unit

Having been selected chief of the technical staff, created on the recommendation of the city's Waste Commission, the necessary engineering and working forces, including waste investigators, were organized and systematic studies begun. At the same time, work on the design and construction of the municipal reduction plant, 95th Street incinerator, Bridewell crematory, and collecting and handling equipment was being carried on. To facilitate this work it seemed to me that somewhere along the line from the production of waste to the point of final disposal a unit should be selected. The most difficult phase of the entire problem is getting the garbage from the kitchen to the collecting unit.

It was for this reason that the garbage box was selected. The larger the capacity of this unit, other things being equal, the less the cost of collecting and handling. Study showed that a six-cubic-yard box when filled became too heavy for a two-horse team, except on the very best of paved streets. As but 13 per cent. of our alleys are paved and 62 per cent. of our streets, this prohibited such a unit being used throughout the city. So, taking all in consideration, the unit adopted appears to be the most satisfactory. This consists of a box 12 ft. long, 4 ft. wide, and 32 ins. high, as shown in Fig. 1.

Two such boxes can be loaded abreast, three in length and two vertically, making twelve boxes per specially designed railway car. One-half this number can be loaded on a specially designed street car. The net loads of garbage contained will be approximately 34 and 17 tons, respectively.

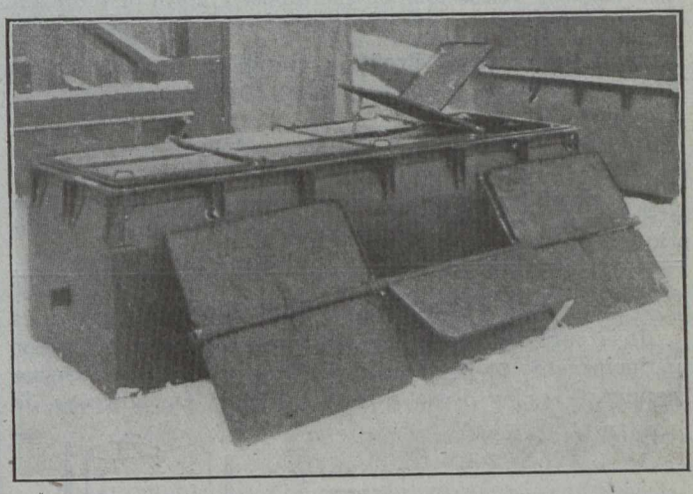


Fig. 1.—Garbage Box. Length, 12 Feet; Width, 4 Feet; Depth, 32 Inches

By adopting a standard collecting unit, hoisting equipment, including cranes, runways and slings; hauling equipment, including wagons and tractors; transporting equipment, including railway and electric cars, steam and tow barges, become standards for loading and disposal stations for various wastes.

The studies so far conducted indicate that it may be considered an axiom that that system handling an offensive substance which exposes the least or fewest surfaces to contact with such substance is the most sanitary, least offensive and in general, commercially the best.

Table 1.—Cost of Garbage Disposal in Chicago for Five Years Previous to Acquisition of Garbage Plant by the City

Year ended September 30.	Amount paid by city.	No. of tons delivered.	Cost per ton.
1909	$ 47,500	$ 89,957	$0.528
1910	47,500	97,087	0.489
1911	47,500	115,364	0.411
1912	47,500	118,225	0.401
1913	47,500	144,343	0.329
Totals	$237,500	$564,976	$0.420

*Abstract of paper presented at a meeting of the Chicago Section of the American Society of Mechanical Engineers.

Table 2.—Average Net Cost Per Ton to the City of Chicago for Handling Garbage at the Municipal Garbage Plant from Time of Acquisition to September 30th, 1916

Year.	Expense of operation.	Revenue.	Net cost of operation.	Garbage received.	Net cost per ton.
	$	$	$	Tons.	$
1914....	154,684.48	96,585.06	58,099.42	75,599¾	0.768
1915....	278,570.35	183,196.83	95,373.52	150,874¾	0.632
1916....	432,721.86	410,512.28[1]	22,209.58	137,920½	0.161
Totals	865,976.69	690,294.17	175,682.52	364,395	0.482

[1] During the year 1916 the extractor plant was in operation but from the first of June, and the mill house was not in full operation until the latter part of June.

From January 1st to the time of starting the extractor plant, the city received only $3.27 a ton for commercially dried garbage, which is green garbage dried down to 10 per cent. moisture.

The capacity of the old mill house was not sufficient to handle all garbage degreased, necessitating the storage of approximately 14,000 tons on the property north of the plant, thereby greatly increasing the cost of production of tankage.

Table 3.—Estimated Profit in Handling Garbage at the Chicago Municipal Plant During 1917

Cost of operation.	Revenue[1].	Net revenue.	Garbage, tonnage.	Net profit per ton.
$477,000	$603,000	$126,000	145,000	$0.869

[1] Price of grease taken at 5 cents per pound and tankage at $5.00 per ton, both figures much below the present market prices.

Cost Figures on Garbage Disposal

It is entirely feasible to construct a reduction plant or an incinerator to operate in a sanitary and inoffensive manner. To lay down a fixed set of rules, however, is not permissible, as the waste problems of each city must be considered as separate and distinct. Generally it costs money to incinerate, whereas money can be made by reduction, as will be seen from Tables 1 to 3.

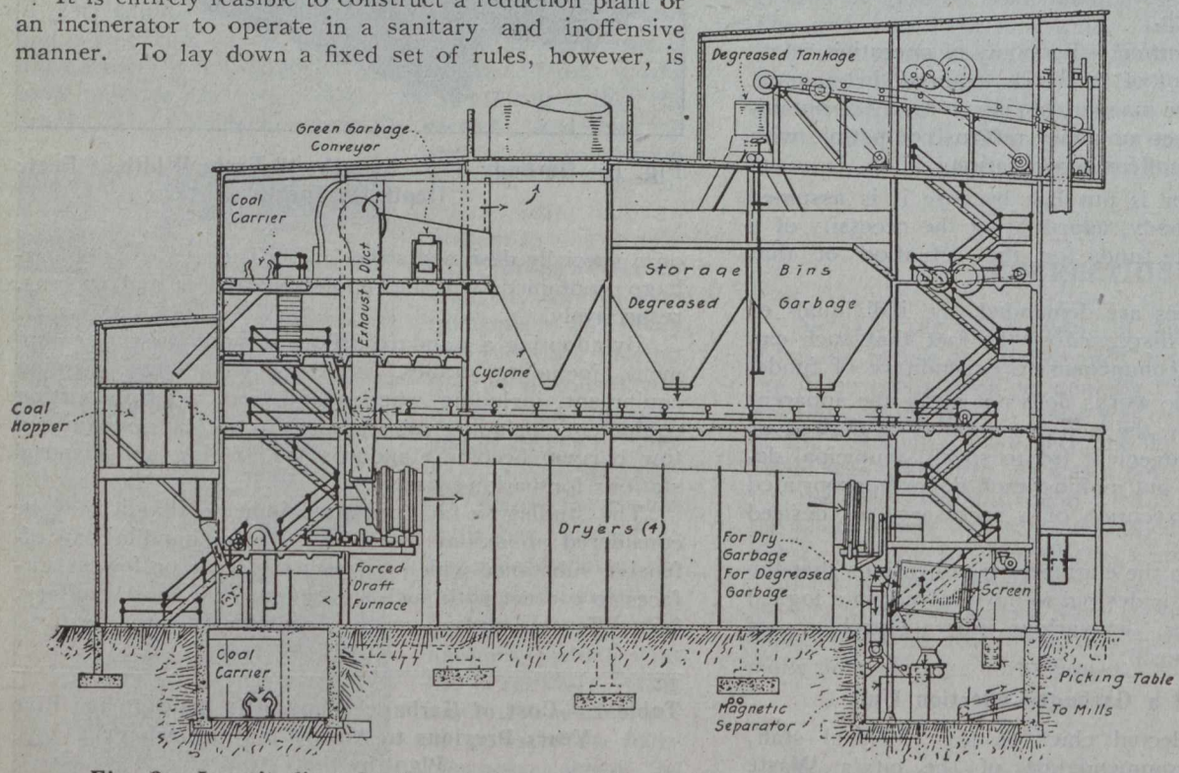


Fig. 2.—Longitudinal Section of Dryer Building, Chicago Municipal Reduction Plant

Systems of Garbage Reduction

Briefly, the following may be considered the present methods or systems of garbage reduction: Cooking process (Arnold and Edgerton), Cobwell system, chemical process, and drying process (Mertz and Simons).

In the cooking process the raw garbage is fed into large tanks called digesters, holding several tons of garbage each. These tanks are then closed and the contents subjected for several hours directly to a steam pressure varying between 40 and 80 lbs. per square inch, the tendency being to break down the cellular structures by boiling.

When the digestion is completed the emulsion of grease and tank liquors is drawn off. The solid matter generally is fed to a press where the main portion of the entrained oil and liquors is forced out, leaving a tankage containing 40 to 50 per cent. of moisture. The tank liquors and grease obtained from the cooking and pressing process are passed through a series of settling tanks or basins in which the grease is separated gravimetrically and drawn off or skimmed from the top.

The tank liquors, which contain considerable fertilizer value, are treated in a multiple-effect evaporator to thicken before mixing with the degreased tankage.

The tankage after pressing is properly dried and subjected in a percolator to the action of a grease solvent which absorbs the remaining grease. The saturated solvent is distilled off and condensed, leaving the grease, the solvent being ready to use again. The degreased tankage and liquor, called "stickwater," are mixed, dried, milled and shipped.

There are several successful reduction plants employing this process, among them being the municipally owned and operated plant of the city of Columbus, Ohio, and privately operated plants at Pittsburgh and Philadelphia.

In the Cobwell system the green garbage is fed into a tub-shaped digester tank of several tons capacity, provided with a steam jacket or interior heating coils, and subjected to the direct action of a grease solvent at a temperature under 200 degrees Fahr. Dehydration takes place for several hours, during which time the vapors are drawn off and condensed. These vapors consist principally of moisture and a portion of entrained solvent. After condensation the solvent is separated from the water and is ready for use again, the water generally being wasted.

During this operation a large proportion of the grease is dissolved in the solvent and the cellular structures for the most part broken down. The saturated solvent is then drawn off.

The tankage remaining in the digester is subjected to one or more washings of grease solvent, for the purpose

of obtaining the greatest permissible amount of grease. The solvent with the dissolved grease is then drawn off and live steam introduced, as in the case of most percolator processes, to drive off as much of the remaining solvent as possible, to minimize loss. The tankage is then subjected to drying under vacuum by heat supplied from the steam jacket or coils. When the moisture content has been reduced to less than 10 per cent., the contained tankage is removed, ground, screened and shipped.

It will be noted in this process that a large portion of the reduction is done in the one tank or digester.

Some of the latest municipal installations employ this system, among which are those in New Bedford and Los Angeles. The city of New York is endeavoring to build a plant, equipped with this process, of 2,000 tons capacity of green garbage per 24 hours, estimated to cost approximately two and a half million dollars. New York is having the common difficulty of securing a suitable location for the plant, owing to the objection of property owners near sites deemed suitable.

The chemical process proposed by Dr. Hirsch has not been demonstrated with the required exactitude to enable competent engineering judgment to be passed upon it. It consists of a treatment tank containing several tons of green garbage, the garbage being subjected to the action of certain chemicals which convert the cellulose into dextrin, or dextrose, depending upon the temperature employed and the time. Personally, I have great hope that such a system may be evolved.

Dr. Morgan claims to have a process by which he produces alcohol directly from garbage. The experiments so far made by him have not yet, I am informed, been sufficiently conclusive to enable an engineering report to be made.

In the three systems above described it will be noted that the green garbage is fed into tanks, which are then closed and the contents exposed to treatment.

Garbage Reduction Process Used in Chicago

The fourth process mentioned is the dryer process and is the system in use at the municipal reduction plant in Chicago. In this process the garbage is generally first run through a crusher to smash open cans of condemned foodstuffs and to break up other large material to permit of more efficient drying. The material from the crusher is then fed into dryers, its moisture content being reduced to 10 per cent. or less. From the dryers it is fed into percolators where it is subjected to the action of a grease solvent. The grease-saturated solvent is then drawn off and the solvent distilled off and condensed for repeated use, the grease being treated and stored ready for shipment. Steam is then turned on to drive off any residual solvent, after which the tankage, which contains about 26 per cent. moisture, is withdrawn and then put through final dryers and dried to about 6 to 8 per cent. moisture. It is then screened, milled and screened and stored ready for shipment.

This system was one of the first employed, but in most cases has been replaced by the cooking process or its latest modification—the Cobwell system. My investigation convinced me that one great cause of offense at the plant of the Chicago Reduction Co. was due to the use of direct-heat dryers and the consequent burning or carbonizing of certain greases and materials such as hair and flesh. This scorching action not only was the cause of offense, but also, I believe, the cause of loss in the amount and value of the by-products. The result was the installation of the more costly direct-indirect-heat dryers.

As predicted, when using the indirect-heat dryers not only has the necessity for scrubbing practically been eliminated, but the tankage and grease produced are better, with consequent increased values. The garbage is dried from 75 per cent. moisture to 10 per cent. or less in one cylinder.

The principal aim in designing this plant was to eliminate offense; therefore, not being content with the results thus attained, I thought it advisable to provide each dryer with a petticoat stack. This stack permits commingling of outside air with the gases escaping from the dryer, therefore cooling and throwing down a certain amount of moisture (which carries with it considerable very fine suspended matter) and in addition causing dilution.

The stacks are provided with suitable sprays, for use in case of any possible emergency due to delayed collection in hot weather or accidental fire or overloading. It will be noted that each dryer is arranged in the newly designed dryer building as a practically complete unit, having its own cyclone and petticoat stack.

SHIPBUILDING AT THREE RIVERS, QUEBEC

Mr. Thos. Mulvey Kirkwood, Toronto, has been granted favors from the city of Three Rivers, Que., for the construction of wooden ships. Mr. Kirkwood has organized the Three Rivers Shipyard Company, Limited, whose bonds are financed by Le Credit Canadien, Limitée, of Montreal, and guaranteed by the city of Three Rivers, as per a by-law passed at a meeting held the 24th of August last.

The promoter has a contract for two sea-going vessels, length between perpendiculars, 250 feet; beam, 43 feet 6 inches; draught, 23 feet; deadweight, 2,700 tons. It is estimated that for the complete building of these the workmanship of 120 carpenters is required for a period of five months for each unit and that the cost of each vessel when completed and ready to go to sea will be approximately $450,000.

The shipyard is situated at the western side of the Three Rivers harbor, and covers an area of some five acres. Dredging is to be undertaken in order to reach the deep water in a basin of 350 feet long, 150 feet wide, with a mean depth of cut of 7 feet. The plant will consist of one two-story machine and pattern shop, 75 feet by 175 feet, concrete foundation and wooden frame; two 250-foot slips on pile foundations, the bottom being clay and sand. Mr. John Bourgeois, Quebec Land Surveyor, and A.M. Can.Soc.C.E., is the acting engineer for the company.

Mr. W. J. Shea, director of the Three Rivers Publicity Office, is to be congratulated upon the success which has attended his efforts to bring such an industry to Three Rivers.

The United States government's shipbuilding programme calls for a total of 1,270 ships, of 7,968,000 tonnage.

A 1,700-mile concrete military highway from the Canadian to the Mexican border, through Montana, Wyoming, Colorado and New Mexico, has been proposed to the United States Federal Government by the Rocky Mountain National Military Highway Association, which was organized in Denver, Colo., recently, State Highway Commissioner Thomas J. Ehrhart being elected president. The tentative route favoured is from Fort Assiniboine, near Havre, Mont., to El Paso, Tex., a distance of 1,696 miles.

POLAR-CO-ORDINATE CHART FOR OBTAINING NORMAL WIND-PRESSURES

By Harry B. Wrigley, Allentown, Pa.

THE normal pressure upon an inclined surface varies with the inclination of the roof. Three formulas for this variation are in common use: Hutton's (derived in 1788),

$$P_n = P \sin A \; 1.82 \cos A - 1$$

Duchemin's (derived in 1829),

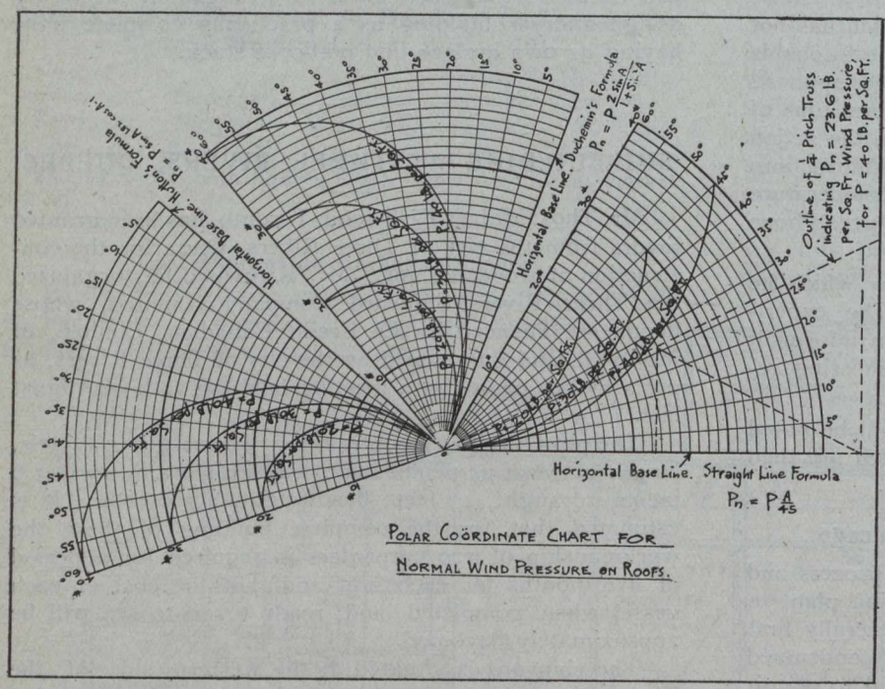
$$P_n = \frac{2 \sin A}{1 + \sin^2 A}$$

straight line (recent),

$$P_n = P \frac{A}{45}$$

where

P = pressure on a vertical surface;
P_n = pressure normal to roof surface;
A = angle which the roof surface makes with the horizontal.



The values in the following table were calculated from the formulas given above and the Polar-Co-ordinate chart plotted from these values will be found very convenient for reading direct the normal pressure at any inclination.

Table of Normal Pressures.

A	Hutton P = 20	30	40	Duchemin P = 20	30	40	Straight line P = 20	30	40
	Values below this line are P_n.								
5°	2.6	3.9	5.2	3.5	5.2	6.9	2.2	3.3	4.4
10°	4.8	7.2	9.6	6.7	10.1	13.5	4.4	6.7	8.9
15°	7.0	10.5	14.0	9.7	14.6	19.4	6.7	10.0	13.3
18°26′	8.7	13.0	17.3	11.5	17.2	23.0	8.2	12.3	16.4
20°	9.2	13.7	18.3	12.2	18.4	24.5	8.9	13.3	17.8
21°48′	10.0	15.0	20.0	13.0	19.6	26.1	9.7	14.5	19.4
25°	11.3	16.9	22.5	14.3	21.5	28.7	11.1	16.7	22.2
26°34′	12.0	18.0	24.0	14.9	22.4	29.8	11.8	17.7	23.6
30°	13.3	19.9	26.5	16.0	24.0	32.0	13.3	20.0	26.7
33°41′	14.7	22.0	29.3	17.0	25.4	34.0	15.0	22.5	30.0
35°	15.0	22.6	30.1	17.3	25.9	34.5	15.6	23.3	31.1
40°	16.7	25.1	33.4	18.2	27.3	36.4	17.8	26.7	35.6
45°	18.0	27.1	36.1	18.9	28.3	37.7	20.0	30.0	40.0
50°	19.0	28.6	38.1	19.3	29.0	38.6			
55°	19.8	29.7	39.6	19.6	29.4	39.2			
60°	20.0	30.0	40.0	19.8	29.7	39.6			
60° to 90°	20.0	30.0	40.0	20.0	30.0	40.0			

MANY SHIPBUILDING CONTRACTS

SHIPBUILDING in British Columbia, which was started on a modern scale only a few months ago, is now an important industry, and contracts for the construction of ships are in hand, the aggregate value of which is $27,500,000. These comprise iron steamers and wooden auxiliary vessels, and the yards are located at Vancouver, Victoria, Port Coquitlam, New Westminster and at Quatsino.

Six steel steamers of 8,800 tons dead weight are to be built by J. Coughlan & Sons, Vancouver, three of which are under construction, the first to be ready about the end of this year. Five are for British account and one for Norwegian, the value of each to be $1,250,000.

The original programme at the Wallace shipyards, North Vancouver, was for six auxiliary power schooners, valued at $150,000 each. Four of these are finished. In addition, one steel ship has already been built and a second is started, while a third is to be built. These ships will cost $650,000 each. The No. 2 yard of this company has been taken over by the Lyall interests of Montreal, which will build six steamers for the Imperial Munitions Board, at a cost of $350,000 each.

The Western Canada Shipyards, on False Creek, will build six wooden steamers for the Imperial Munitions Board, two having been started. The aggregate value of these will be $4,500,000. The British Pacific Engineering Company, Vancouver, has a ship construction program of about $1,500,000. The Taylor Engineering Company, Vancouver, has taken up the designing of ships, and is constructing small ships of a total value of $300,000.

The Vancouver Shipyards and Engine Works, a new concern, has located a yard on Burrard Inlet and will build ships for sale instead of on contract. The Whalen Pulp and Paper Company, which has its offices in Vancouver, with pulp plants at Mill Bay on Howe Sound, Swanson Bay and Quatsino, west coast Vancouver Island, will build ships at Quatsino for its own uses, and will lay two keels immediately.

The Cameron-Genoa Mills, Shipbuilders, Limited, Victoria, has launched four wooden auxiliary power schooners, and two more are to be built. These cost $150,000 each. It will also build four wooden steamers for the Imperial Munitions Board, of a total value of $1,400,000.

The Foundation Company has leased Turpel's shipyard, Victoria, and is constructing five ships for the Imperial Munitions Board, approximate value, $1,750,000. Yarrows, Limited, Victoria, is building four shallow draught steamers for river navigation in India. The British Columbia Construction and Engineering Company is establishing yards on Poplar Island, New Westminster, and will build four steamers for the Imperial Munitions Board, at a cost of $1,400,000.

Harrison and Lamond, South Vancouver, have a contract to build an auxiliary schooner for the Dominion government for the trade between the Pacific and the Atlantic, the cost to be $150,000. Other concerns having shipbuilding plans are the British Columbia Marine, Sound Construction Company, Victoria Machinery Depot and the Westminster Marine Ways.

PROPOSED UNION OF RAILWAY LINES AT SASKATOON*

By C. J. Yorath, A.M.Can.Soc.C.E.

IN considering the future and planning for the growth of the city it is essential that the question of railway facilities both in respect to freight and passenger traffic should be carefully studied and a plan agreed upon whereby the future development of this utility will be such as to give the best possible service to aid industrial and commercial expansion without unduly impeding transportation facilities within the city and causing large expenditures to be borne by the taxpayers in constructing subways, etc.

A badly planned disintegrated railway system within a city invariably entails considerable loss to commercial enterprise, increases the cost of living and gives cause for unnecessary annoyance and loss of time to the travelling public. The loss through a badly planned railway system in a small city amounts to a very large sum annually, and in larger cities such a system not only entails a considerable annual monetary loss but also involves the citizens and the railway companies in very large expenditures in altering and re-planning their system on lines and in accordance with plans which could easily have been foreseen had a little foresight been exercised in the initial stages of development.

At present the city of Saskatoon is served by three railways, the Canadian Pacific, the Canadian Northern and the Grand Trunk Pacific.

From the attached plan it will be seen that the Canadian Northern and Canadian Pacific Railways enter the city at the northeast corner of the city limits, the former approaching from the north and the latter from the east. They cross each other at the junction of 33rd Street and 3rd Avenue and continue through the city on the west side of the river, crossing the city limits again on the west side immediately adjoining each other. The Canadian Northern Railway also enters the city from the south side across the Saskatchewan River.

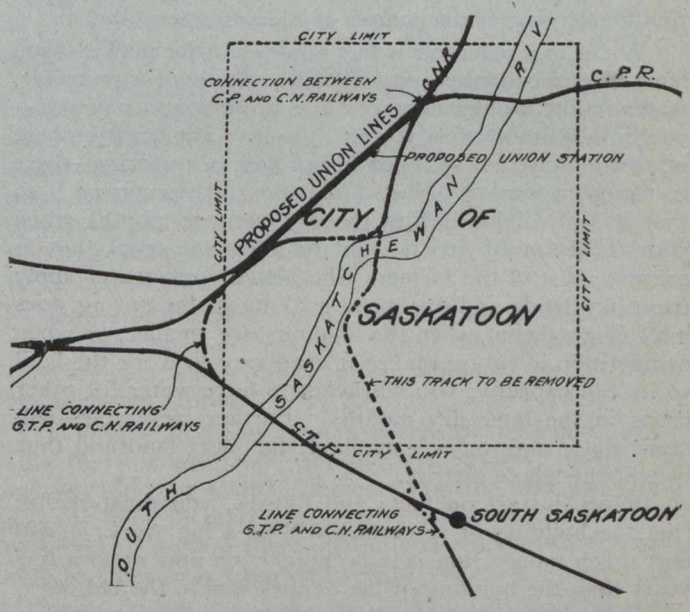
The Grand Trunk Pacific Railway only passes through the extreme southwest corner of the city, and has no communication with the centre of the city. The C.N.R. depot is on First Avenue, opposite 21st Street, and the C.P.R. depot is on Avenue A, opposite 23rd Street, while the G.T.P. depot is 3.34 miles south from the post office. The Canadian Northern freight yards are in the centre of the city between 19th Street and 23rd Street and the C.P.R. freight yards are north of 24th Street between the two main lines. The G.T.P. has no freight yards in the city. The tracks within the city limits are practically on the level of the surrounding ground which entails a considerable number of level crossings with their attendant inconveniences and danger. This very undesirable state of affairs is likely to be augmented rather than diminished if the Grand Trunk Pacific should enter the city by an entirely separate route to that of the C.P.R.

With the above system of railways and the Saskatchewan River it will be seen that the city is badly divided into no less than nine distinct zones, *i.e.* :—

South and east of the Saskatchewan River—(1) East of the C.N.R. tracks, (2) west of the C.N.R tracks; north and west of the Saskatchewan River—(3) centre between the C.N.R. tracks and the river, (4) east centre between C.N.R. and C.P.R. tracks, (5) south and east of the C.N.R. tracks, (6) west of the C.P.R. and C.N.R. tracks, (7) north of the C.P.R. tracks and east of the C.N.R. tracks, (8) north of the C.P.R. tracks and east of the Saskatchewan River, (9) south of the C.P.R. tracks and east of the Saskatchewan River.

The divisions of the city by these railways and the river causes considerable extra expense in civic administration and the development of the city and if the Grand Trunk Pacific Railway should in the future enter the city by any other route than over the existing lines the city will be still further divided and an additional cause for increasing the city's debt will be created.

Some of the results of dividing the city into so many zones are: (1) Increased cost of fire protection; (2) increased cost of sewerage system; (3) increased cost of water distribution system; (4) increased cost of police patrol; (5) increased cost in operation of city's cleansing and street departments; (6) increase in debt due to large expenditures in constructing subways. Over $350,000



has already been expended on constructing subways but this amount is likely to be increased to two or three millions if the railways are extended upon their present system; (7) increased cost of transit from one part of the city to another.

The railway situation is such in Saskatoon that at very small cost the three railways can be made to pass through the city in one line. In order that this may be done it would be necessary to make connections between the Grand Trunk Pacific and Canadian Pacific Railways at a point some distance northeast of the city; between the Canadian Pacific and Canadian Northern Railways north of the city; between the Grand Trunk Pacific Railway and the Canadian Northern Railway at or near South Saskatoon, and between the three railways on the west side of the city. With equal running rights through the city it would then be feasible to arrange at comparatively small cost compared with what the cost will be if the railway system is allowed to develop in a haphazard manner (*a*) an elevated railway through the city, (*b*) a central union passenger and freight depot, (*c*) freight yards at the northeast and southwest sides of the city, (*d*) engine facilities and coach yards serving all the roads using the union depot.

*From special report on the Unification of the Railway System in Saskatoon.

RESERVOIRS IN THE CYPRESS HILLS DISTRICT*

By F. H. Peters, M.Can.Soc.C.E.
Commissioner of Irrigation and Chief Engineer, Department of Interior, Calgary.

WHENEVER one studies the stream run-off of any of these streams in this district one main fact stands out clearly, namely, that in nearly every year about 75 per cent. of the total annual flow runs off in March and April, which is long before the time that the water is most needed on the fields, or will do most good if applied. When we consider this and also note that, periodically, there are wet years with floods in the water, even if it was spread evenly over the season and that, periodically, there are wet years with floods in the spring that do very great damage, we see immediately that there is only one cure for all these troubles, and that is reservoirs. The Cypress Hills water users are having the same experience as all other irrigation developers on streams on the prairie not fed by mountain snows. In fact, it may be said of all streams that the greatest question concerning water supply is always reservoirs.

Water in a reservoir is like money in your pocket—you have it to spend when you want it. Without a reservoir, water is like money some one has promised to pay you—you do not know when you will get it. The question here is, fortunately, not so much one of lack of quantity—there is enough water—it is just a question of reservoiring it so that it is available during the dry summer months when your fields need it. I want to make the point that at present most of the farmers who actually use water apply it on hay lands and one good soaking in the spring does a lot of good, but when the holdings are smaller, or when competition in future makes it necessary to work the land to its full capacity, you will want to have water for other crops in the later dry months. Further, reservoirs will store water and make it available for more land and thus benefit the whole district.

Before I start on facts and figures, you must realize that the building of reservoirs will be a big work, it will cost much money, but it is no bigger job now or in a few years than the building of the ditches was in the old days, when you were not so well established. Because it is a big job we must tackle it early so as to make haste slowly but surely. We must study the question from all angles, collect all data possible, get cost figures, etc., so that when the right time comes everything will be properly lined up.

You must also realize that this is a very complicated engineering question, to decide just how big the reservoirs should be, just how much water we can rely on saving, and so on. I do not present this paper as the final word in the matter, but rather have tried to put the matter before you in a general but true light, anticipating that as time goes on our records will be more complete, and that when active agitation for the building of any reservoir takes place, that will be the proper time to make the final study of each case.

Cypress Lake reservoir was completely surveyed in 1913 and all the necessary data for estimating capacity and cost is available. In the report of the Irrigation Branch, published in 1914, the capacity and cost was figured for a dam 22 ft. high at the east end. The cost per acre-foot stored is very reasonable, $3.80, but when we reckon on the cost per acre of land which can be irrigated and which land must pay for the reservoir, it runs into the higher figure of $16 per acre, based on irrigating 31,000 acres.

At the present time we are able to estimate on the matter of water supply a little more closely because we now have more records available and the more recent survey of the Fifty Mile reservoir also affects the question.

In the irrigation report referred to above it was assumed in considering water supply that two or three wet years like 1912 might follow each other and that water would be stored for successive dry years like 1910 and 1914. This method of study led to the adoption of a reservoir capacity of 126,000 acre-feet which is no doubt amply large and would give complete storage for all water available under any conditions which might arise. Making a more recent study of supply and demand based on stream flow records for 1911 to 1916 it is found that under these conditions a reservoir with a capacity of about 90,000 acre-feet would be large enough based on storing all the water available, absorption losses of 3 feet in the reservoir and a gross duty at the reservoir of 1.5 acre-feet.

The study showed that the water supply available was sufficient to irrigate 21,531 acres only. The cost of the reservoir would, however, be reduced to about $340,000, making the cost per acre-foot stored about 3.77 and the cost per irrigable acre the same as before, about $16. This is just the same cost per irrigable acre as that originally figured, so that we may consider this price not far wrong.

In connection with this reservoir, the only engineering point about which there is any question, arises in connection with diverting the early spring run-off into the reservoir through the made canals. Those of you who were interested enough to read the report published in connection with the survey made will remember that it is planned to divert Battle Creek, Belanger Creek and Davis Creek into the reservoir through made diversion canals. This spring run-off, which produces practically all the water for storage, takes place in March and April and there may be very considerable difficulty in operating the diversion canals at this season of the year due to snow and ice conditions. Another point which should be noted is that in each year there is a certain quantity of water flowing into the streams below the reservoir which cannot be controlled. We have estimated that whatever quantity is available from this source will be used as it comes, in satisfying the water rights on all the irrigable land below the reservoir, up to the limit of getting 50 per cent. of the required water in this way. In four out of the six years studied the irrigators would have had to take less than 20 per cent. of their supply as it came uncontrolled, mostly in the early spring and in two of the years they would have had to take 50 per cent., the remainder being figured as wasted. This feature is not very desirable, but was adopted so as to store and save as much water as possible for the driest years when it is most needed.

To complete the storage problem for the Frenchman River we will take up the Fifty Mile reservoir. Surveys have been made of this site by the Irrigation Branch so that details as to capacity, cost and water supply are available. Studying this reservoir in the same manner as Cypress Lake we have adopted a dam height of 55 feet, giving a reservoir capacity of 52,000 acre-feet. This works out at $6.84 per acre-foot stored and nearly $21 per acre of irrigable land to be served. This is based on serving an irrigable area of 17,000 acres. It has been estimated that there are 24,000 new acres which can be

*Abstract of paper read before the Western Canada Irrigation Association, Maple Creek, Sask.

irrigated on the Frenchman, all below this reservoir. The 8,000 odd new acres estimated to be served from Cypress Lake also lie below the Fifty Mile reservoir, so together our study provides water for a little more than the estimated acreage. The water for the 8,000 odd acres is to be held in the Cypress Lake reservoir, because it is cheaper to provide the storage there than in the Fifty Mile.

To sum up, then, for Battle Creek and Frenchman River, we are dealing with a total irrigable area of 45,708 acres. On Battle Creek, water can be stored for 5,231 acres now developed and 2,000 new acres for $16 per acre. There are still 3,475 acres above the reservoir and 185 acres on tributaries below, which cannot benefit directly by the reservoir. On Frenchman River there are 5,422 acres now developed and 8,878 new acres for which water can be stored at $16. There are an additional 15,122 new acres which can be served by reservoir water at $21 per acre. There are still 2,494 acres above the reservoirs and 2,901 acres of tributaries below which cannot be directly benefited. That is, 80 per cent. of the irrigable land can be provided with reservoir water and 20 per cent. cannot be so provided. While the irrigable acres above the reservoirs and on the tributaries could not benefit directly by the reservoirs they probably could do so indirectly by paying a certain percentage of the cost of the reservoir and thus buying all the low-water flow which could be used by them in lieu of flood waters stored and which could be equally well used by the irrigators below the reservoirs.

The Middle Creek reservoir was also completely surveyed in 1913 and all the necessary data for estimating the capacity and cost is available. While it is feasible to divert water from Middle Creek into Battle Creek and thence into Cypress Lake reservoir there would be no object in this since the reservoir site on Middle Creek is large enough to store all the water available and control it for use below on the same creek.

The most recent study of supply and demand conditions for this reservoir, based on the actual stream records for 1911 to 1916, adopts a reservoir capacity of 15,000 acre-feet as the most desirable and which is sufficient to control the total supply available which occurred during these years.

The cost of this reservoir is estimated at $66,458, making the cost per acre-foot stored $4.43. The total area which could be served is 3,130 acres, which comprises 1,530 acres now developed and 1,600 new acres out of the area which it has been estimated can be irrigated and lie below the reservoir. Based on 3,130 irrigable acres, the cost of this development is $21.23 per acre. Considering the whole of Middle Creek, there is an additional irrigable area of 1,271 acres lying above the reservoir and 97 acres on tributaries below which cannot be served from the reservoir. In addition to this, 792 acres of irrigable land will be flooded out by the reservoir.

It is to be noted again that in the study made as above, all the additional uncontrolled flow in the creek below the reservoir is assumed to be utilized, as it occurs naturally and mostly in the early spring. The percentage of the total supply which would have had to be used in this way in the study made would average 68 per cent.

There are no difficult engineering features in connection with this reservoir, but viewed from an economic standpoint there are two bad features in the high absorption losses from such a shallow reservoir, and the fact that so much irrigable land has to be flooded and its productive value therefore permanently ruined.

We estimate absorption losses of at least 3 acre-feet per acre of water surface in the reservoir. The duty on the land is estimated at 1.5 acre-feet, so that for every acre of water surface in the reservoir we lose enough water to irrigate two acres of land below. The water surface in this reservoir would be about 1,000 acres, so that in order to save water enough to irrigate the 3,000 odd acres below, we are forced into losing water enough to irrigate 2,000 acres. There is no way of overcoming this loss if we try to store water over from year to year, which it is necessary to do in order to provide the maximum conservation of water.

Then again, in order to benefit 3,130 irrigable acres below we have to destroy 792 irrigable acres in the reservoir site. That is to say, that for every four acres benefited, we have to destroy one acre. If we adopt the viewpoint that we have plenty of land out here in the West, there seems to be no objection to this, but when we consider that the whole proposition is one for the reclamation of, and added productivity to, certain lands for the benefit of not only the few people owning the lands improved, but for the benefit of the whole community, it is difficult to justify the destruction of such a high ratio of equally good land in the reservoir.

We will now consider Maple Creek watershed, on which we have investigated the four reservoir sites noted above. The first two reservoirs have small capacities of 1,954 acre-feet and 418 acre-feet. Their cost of development would be rather high also, $12.62 and $16.70, respectively per acre-foot stored, so that probably they will not be developed until after the latter two, which appear to be more favorable sites.

Downie Lake reservoir is the cheapest of any that we have investigated in the Cypress Hills, having an available capacity of 4,200 acre-feet, at an estimated cost of $1.50 per acre-foot stored.

We have no direct stream records of the supply available for this reservoir, but our estimations, based on records for 1911 to 1916, indicate that the reservoir could be fully filled in three years and only about half filled the other three, so that there probably is not the water available to store over from one year to another.

Maple Creek reservoir No. 9 was surveyed recently and the cost taken out for a reservoir capacity of 3,200 acre-feet. This capacity would not be nearly great enough to store all the water that is available from Maple and Gap Creeks, and a further tentative study has been made, based on raising the dam 5 feet, which would increase the capacity to about 6,230 acre-feet and the cost to about $57,640 or $9.25 per acre-foot stored. In either case the reservoir is not big enough to store all the water available and it would not be large enough to store water over from year to year.

Considering Downie reservoir and No. 9 together, there are 5,086 irrigable acres now developed below them. On the basis of using these reservoirs to store the spring freshets for use later on the same year only, and figuring absorption losses for two or three months, each year we might, by using the larger capacity for No. 9, have available there about 5,400 acre-feet and in Downie about 2,000 acre-feet. This total of 7,400 would store enough to provide practically a full duty of 1.5 acre-feet for the irrigable land between and assessing the total cost of $64,240 against 5,158 acres would amount to $12.45 per acre.

Discussing the watershed again in a general way, we have four reservoirs, with a maximum capacity of 12,802

acre-feet, assuming that the three upper ones could always be filled. The stream records of the total flow occurring above the lowest reservoir for 1911-1916 show an average water supply of 20,266 acre-feet varying from 8,660 acre-feet to 34,745 in dry and wet years. Lying below the four reservoirs there are 5,378 acres of irrigable land and above them 1,178 acres.

The development of the reservoirs as indicated above would give an assured and fully controlled supply to all the irrigable land now developed. It would also allow of new irrigable land utilizing the surplus spring flow during the wet years, say, four out of every six, but the new irrigable land would have no assurance of supply during the other two years if we accept the run-off for 1911-1916 as typical.

SOME CHARACTERISTICS OF THE ACTIVATED SLUDGE PROCESS OF SEWAGE TREATMENT*

By Almon L. Fales

Of Metcalf & Eddy, Consulting Engineers, Boston & Chicago.

THE most recent development in the art of sewage treatment is the activated sludge process. This method of treatment is unique in that the process may be adapted to accomplish clarification without stability, or it may be carried to the point of producing a stable effluent without much excess of available oxygen, or it may be carried still further to the point of producing a highly nitrified effluent comparable with that from the intermittent filter.

Requisites of Process

The requisites of the activated sludge process are:

1. A sufficient proportion of bacterially-active sludge.

2. Intimate mixture of the activated sludge with the sewage to be treated.

3. A supply of atmospheric oxygen ample for the bacterial demand.

4. A time of contact, or period of aeration sufficient to accomplish the desired degree of purification.

5. A temperature of aeration not too cold nor too warm for bacterial growth.

Activated sludge may be obtained by sufficient aeration of successive portions of sewage. A proportion equivalent to about 25 per cent. of the volume of sewage to be treated, is usually sufficient.

Intimate mixture of the activated sludge with the sewage may be secured by the proper application of the air which is required to support the bacterial life upon which the process depends.

The air must be uniformly distributed through the mixture, in order to supply all parts of the liquid with ample oxygen. A period of aeration of 4 hours appears to be sufficient for ordinary sewage. The indications are that about 1.75 cu. ft. of air per gallon of sewage will suffice under ordinary conditions.

Satisfactory results have been obtained even during winter weather, although it appears to be difficult to secure nitrification at cold temperatures.

Means of Air Diffusion

Theoretically, at least, the air must be well diffused in order to be used economically, and as the compressed air is one of the chief elements in the cost of sewage treatment by this process, the question of air diffusion is a very important one. Porous plates—of such materials as filtros, corundum and certain woods—are well adapted for the diffusion of air, but fear is expressed that such materials will become clogged in spite of all precautions, such as washing the air to be applied.

The consensus of opinion at the present time appears to be that something must be sacrificed in theoretical efficiency in favor of the more practical means, such as perforated pipes.

Theory of Action

Activated sludge is a light, flocculent substance, brown in color and earthy in odor. It contains large numbers of bacteria which appear to be essential to the process. When activated sludge is brought into contact with sewage, it will attract and absorb the suspended and colloidal matters and a portion of the dissolved matters, and submit them to bacterial oxidation.

The extent of oxidation of the absorbed organic matters will depend upon the period of contact afforded. It is possible, by lengthening the period of aeration, to secure a large percentage digestion of the sludge, occasioned by the transformation of organic matters into gases. It is possible to carry the aeration to the point of over-activation of the sludge, resulting in the disintegration of the sludge flocculi and a consequently muddy-appearing effluent.

Under-activation is characterized by a darker, more feathery and more voluminous condition of the sludge. If the sludge remains without sufficient air it will become disagreeable in odor, due to purification, and will finally become deactivated.

Method of Operation

The activated sludge process is carried out in tanks operated either on the fill-and-draw plan or upon the continuous flow principle. In the former case the tank is filled with the sewage, aerated for the required period of time and then allowed to settle, after which the clear, supernatent water is drawn off ready for the next tank-filling. In the latter case, sludge will be carried out of the aeration tank with the effluent and must be removed by sedimentation tanks and returned in proper proportion to the incoming sewage. It may be advantageous to re-activate the sludge so removed, before it is returned to the sewage.

Disposal of Activated Sludge

The activated sludge in excess of that required for the treatment, must be disposed of, and as the volume of such sludge is relatively large, the problem of its disposal is a serious one. Owing to its gelatinous nature and high water content—about 95 per cent.—it does not dry out as readily on sludge-drying beds as some other kinds of sewage sludge. After drying to a spadeable condition it is likely still to contain in the vicinity of 75 per cent. water. It may be readily filter-pressed to about the same water content.

Analyses of dried activated sludge indicate that it has greater fertilizing value than other sewage sludge, owing principally to a larger nitrogen content and a greater proportion of nitrogen available for plant food. Attention is now directed to the problem of dewatering and drying this sludge, at a cost which will either greatly reduce the cost of sludge disposal or actually make sludge disposal commercially profitable.

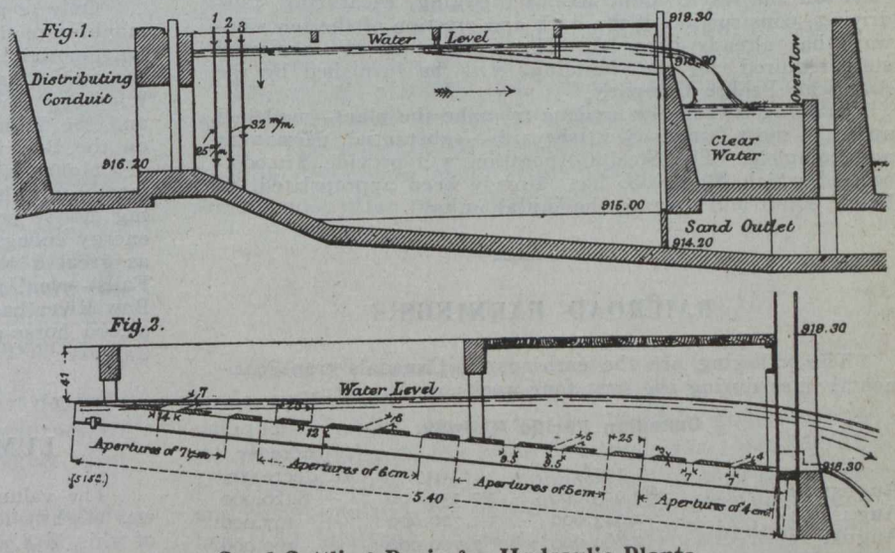
*From an address to the American Chemical Society.

SAND-SETTLING BASIN FOR HYDRAULIC PLANTS*

THE sand-settling basin which we illustrate in Figs. 1 and 2 on this page was adopted by the Aluminium Industrie A.G., of Neuhausen, a suburb of Schaffhausen, on the Rhine, Switzerland, for their new hydraulic power plant near Sitten (Sion), on the Rhône. Sand had caused trouble in the turbines of the company, and had occupied the particular attention of their general manager, Dr. M. Schindlor; the arrangement illustrated is due to Mr. J. Büchi, of Zürich, who describes it in the "Schweizerische Bauzeitung" of June 23rd; we are indebted to our contemporary for our diagrams. The waters to be dealt with are those of the Borgne, which comes from the high Alps south of Sitten, and of the Dixence; the two rivulets are now joined near Santerot. Cleared of their gravel, the waters enter a longitudinal distributing conduit, from which they pass into the settling basin, which is divided into 10 chambers, each 10.5 m. long and about 2 m. wide; the depth of these chambers increases from 3 m. to 5 m. The clear water overflows at the end of the chambers, and the deposited sand is discharged through sluices at the bottom of the chambers. In the experiments made by Dr. Schindlor and Mr. Büchi before the adoption of the device the rate of flow through a chamber ranged from 800 litres up to 1,060 litres per second, the higher figure being equivalent to about 220 gallons per second. When the water was sent into the empty chamber, devoid of any fixtures, as shown in Fig. 1—the view, Fig. 2, represents part of the longitudinal section of Fig. 1 on a larger scale, with the fixtures—the main current, constricted at the entrance (Fig. 1), kept first near the bottom of the chamber, and then curved up to the overflow. The stream-lines, observed by means of dyes and powdered sealing-wax, were very close to one another, and fine particles of sand were carried away over the overflow, only coarse sand particles settling on the bottom. All that was expected, of course, and was in accordance with the determination, by means of Amsler vanes, of the rates of water flow. Various devices were tried to obtain a uniform current of reduced strength; vertical gas pipes proved most efficient, and they were arranged in three rows (Fig. 1), grouped closer in the middle than near the sides of a chamber; they were pipes of 25 mm. and 32 mm. (1 in. or 1¼ ins., about).

Since it was not feasible to experiment on the quantity and size of the sand grains in the turbid summer water of the rivulets, sand grains were introduced, near the point market by an arrow (Fig. 1), into the clear winter water through funnels reaching to different depths, and the rate of their settling was determined. It resulted that the upper layers of the water became clear within a few metres from the introduction of the sand.

This observation was utilized to increase the efficiency of the device. If it were possible to withdraw (by suction, *e.g.*) this upper layer of clear water, the water remaining in the almost unchanged cross-section would flow less rapidly, and the sand would settle more quickly in paths more nearly vertical. If the withdrawal of the cleared-water layer were repeated several times as the water approached the end of the basin, the cross-section would be more and more relieved and the paths of the grains of sand would become more and more vertical. To effect this repeated withdrawal, baffle boards were introduced in the upper portion of the basin, and they were first, during the experimental stages, not rigidly fixed, as in Fig. 2, which represents the actual arrangement, but in louvre fashion. Each baffle could turn about its pivot in a lateral framing, so as to be set at any desired angle; by thus varying the widths and axes of the channels through which the water was withdrawn, the flow could be distributed so as to be uniform all over the baffle partition or irregular as desired. The final arrangement will be understood from Fig. 2. All the boards are fixed in the same inclined plane, but the edges of the boards are cut off obliquely, and they are so spaced apart that the open channels have a width of 7 cm. near the water-level, and lower down widths of 6 cm., 5 cm., and finally 4 cm., while the oblique spacings or apertures are 14 cm., 12 cm., 9.5 cm. and 7 cm. The result obtained was that the stream-line motion filled practically the whole basin, and



Sand Settling Basin for Hydraulic Plants

that the stream lines were much less crowded, being nearly parallel near the top and more curved and further apart near the bottom of the basin. Eddies were not altogether avoided, but they were slight.

The arrangement was tested by adding sand grains of different sizes to the water, the amount of sand added in one experiment of 30 minutes ranging from 44 kg. to 61 kg. The sand was sorted into fine grains (up to 0.6 mm. diameter), medium (0.8 mm.), and coarse grain (1.5 mm.), 100 kg. containing 20 kg., 29 kg. and 51 kg. of the different grains; the average weights of the grains were: fine, 0.13 mg.; medium, 0.34 mg.; coarse, 0.75 mg. per grain. When the sand was thus introduced near the water-level, a little beyond the third row of gas pipes, the deposit consisted of 51 per cent. of the fine grains, 86 per cent. of medium, and 97 per cent. of coarse grains. The practical conditions are, of course, much less unfavorable, since all the sand comes in with the water, the cross-section of which is constricted to nearly half the height of the basin at the inlet. When the sand was introduced at half the height of the basin, or 15 cm. above the bottom, the figures improved very much, and were considered sufficiently promising to justify the construction, which worked satisfactorily during the summer, 1916.

*"Engineering," London.

The actual amount of sand carried by the Borgne water varies from 0.4 gramme up to 1 gramme per litre, reckoning only sand grains above 0.3 mm. diameter. The settling in the basin is, of course, not uniform; the coarse particles are found near the water inlet, finer grains further off.

MAMMOTH SHIPBUILDING PLANT UNDER WAY

The comprehensive plans and specifications prepared by the Federal Shipbuilding Company of the United States reveal the intention of the United States Steel Corporation's interests to build the largest shipbuilding plant in the world in the Hackensack meadows. Each of the ten shipways will be 450 feet to 500 feet in length, but later when more slips are provided some of the ways will be extended to permit the construction of giant ocean boats nearly 1,000 feet in length. The steel buildings will cover ten acres, including a mammoth plate mill nearly 1,000 feet in length, machine structural, fabricating and assembling shops and a great power plant. Marine boilers and engines and electric fittings will be manufactured on the premises. There also will be a wood-joining shop.

An indention of 1,000 feet is being made into the land for the basin, which will be 220 feet wide, large enough to permit the simultaneous fitting of five or six ships after they come off the ways. Contract for dredging, excavating, pile-driving, construction of the dock and erection of the ten shipways has already been let. The 10,000 tons of fabricated steel required for the buildings will be furnished by the American Bridge Company.

Nothing will be left undone to make the plant—modelled upon the most famous Scottish yards—substantial, permanent and complete. The Steel Corporation will provide $10,000,000, of which $6,000,000 has already been appropriated, to build, equip and operate the initial units.

RAILROAD EARNINGS

The following are the earnings of Canada's transcontinental lines during the first four weeks in August:—

Canadian Pacific Railway.

	1916.	1917.	Increase or decrease.
August 7	$2,985,000	$2,559,000	— $426,000
August 14	2,943,000	2,746,000	— 197,000
August 21	2,860,000	2,700,000	— 160,000
August 31	4,092,000	4,018,000	— 74,000

Grand Trunk Railway.

August 7	$1,256,376	$1,320,706	+ $ 64,330
August 14	1,236,989	1,320,753	+ 83,764
August 21	1,304,848	1,371,233	+ 66,385
August 31	1,952,163	2,008,128	+ 55,965

Canadian Northern Railway.

August 7	$ 868,000	$ 775,500	— $ 92,500
August 14	841,500	746,800	— 94,700
August 21	846,300	748,500	— 97,800
August 31	1,129,100	1,134,400	— 5,300

The total income derived from Chinese railways during 1916 amounted to $30,997,471, an increase of $2,415,800, compared with 1915. The total expenditure incurred was $14,839,614, or $265,140 less than the previous year.

The French Government is understood to be on the point of closing contracts for forty more steel cargo boats, each of 4,500 tons capacity, with American builders on the Atlantic coast. Each of the ships will require about 1,500 tons of steel.

The National Congress of Peru, at its last session, passed a highway law, having for its purpose, the encouragement of road construction throughout the country. The new law distributes the cost of new construction between the local and the national governments, and provides both for new revenues for this purpose, and for the payment of a road tax, either in money or labor.

WATER POWER OF WESTERN CANADA

The London Financial Times, in speaking of the enormous undeveloped water power of Canada, says that there is not much doubt that, given the necessary capital for its development, this power alone should suffice to place the Dominion among the foremost of the world's producers of manufactures. Western Canada is not the least section which nature has so beneficiently endowed with this splendid advantage, and it is calculated that 6½ millions of horse-power run to waste daily in the three western provinces. The following note, furnished by the Canadian Pacific Railway Company and based on the investigations of the water powers branch of the Canadian Department of the Interior, is therefore of very considerable interest:—

Investigations conducted by the water power branch of the Canadian Department of the Interior have revealed that in the great Saskatchewan River and its tributaries, which drain the whole of the southern portion of the provinces of Alberta and Saskatchewan, and in the Winnipeg River and other streams flowing into Lake Winnipeg, there is enough hydro-electric energy to create at least 1,172,000 horse-power. In the Athabasca, Peace, Churchill and other enormous streams which drain the northerly portion of the three provinces, flowing, some into the Arctic Ocean and some into the Hudson's Bay, there is enough to create—according to the very incomplete data that has been obtained—5,465,000 horse-power.

Only 12 plants have actually been established yet to avail mankind of this extraordinary volume of power. Only 109,000 horse-power is as yet being used, of which 107,000 is handled through four plants. These latter consist of two on the Winnipeg River, belonging to the Winnipeg Electric Railway and the Winnipeg Municipal Railway respectively, and two on the Bow River at Kananaskis, 50 miles west of the city of Calgary, where 31,000 horse-power are developed and used mostly in lighting Calgary, running its street-cars and supplying motive power at cheap rates to its industries. There is energy enough in the Winnipeg River to produce, eventually, as great a volume of power as is now taken from Niagara Falls—even, possibly, to surpass it; there is enough in the Bow River basin, supplemented by storage capacity, to create 93,000 horse-power, all within easy transmission reach of Calgary.

LUMBERING AND SHIPBUILDING

The value of the lumber, lath and shingles cut in 1916 was slightly less than in 1915, and amounted to $66,072,222; of this $58,365,349 represents lumber, of which 3,490,550 thousand feet board measure were cut as compared with 3,842,676 in 1915, says the monthly commercial letter of the Canadian Bank of Commerce. In eastern Canada the prospects for the lumber industry have been improved by the partial removal of the British embargo placed on shipments on private account. Canadian shipments are now permitted without licenses from the British controller of timber supplies, when forwarded as deck cargoes. Purchases by the Imperial authorities have been insignificant in amount. Production has been limited by the enlistment of large numbers of men in forestry battalions for service in Great Britain and France. In spite of this decided handicap and the resulting decline in quantity, the value of the output for the current year will probably be about the same as for last year.

In British Columbia the mills continue to operate as fully as the labor supply will permit. There is some increase in the local demand arising out of the improvement in general conditions, but the prevailing activity is sustained chiefly by orders from other provinces and from abroad.

The steel and wooden craft in course of construction at the present time in British Columbia yards are valued at $20,000,000. Among the vessels being built are two for the Dominion government, eight for the Imperial government, four for Norwegian shipping houses and seven wooden schooners for the lumber trade. This activity had its inception not more than a year ago and its development has had a very inspiriting effect upon the business of the entire province. The traffic of the port of Vancouver during the 12 months ending March 31st last, was the heaviest on record, the vessels entered inwards and outwards numbering 21,301, and registering 11,735,984 tons, as compared with 9,942,197 tons in 1916, and 10,347,563 tons in 1915.

Editorials

HUMAN REACTION

There are two types of men as subordinates neither of whom is satisfactory; one never by any chance agrees with you and the other never differs. It is usual to regard the latter as a slimy individual whose reservations of mind are matched only by a desire to curry favor. The attitude of agreement by inference is safe; the atmosphere of debate is apt to cause disturbance, hence the man who never by any chance helps to throw light upon a proposition cannot be held to blame when the said proposal fails.

The dissentient who never by any chance is willing to subordinate his views to reasoned statement and who remains unconvinced by the evidence never so strong is the counter-irritant to the first type.

Both are reprehensible and cause trouble, yet probably both are in some measure the product of past experience and environment.

The attitude known as obedient to orders, though they break owners, has wrecked many promising schemes, yet how often is criticism or protest allowed from the man lower down?

The chief gets a new idea and if he be both strong and enthusiastic the employee considers it waste of breath to point out obvious consequences. He thinks it better to put in a practical disclaimer in the shape of useless operation rather than say overmuch at the time. Where the chief seeks advice it is usually freely tendered but if this be adverse he is apt to be more than ever convinced of his infallibility.

The whole matter has two distinct sides and it depends in the main upon human reaction whether coincidence or dissent in any matter with the chief depends largely upon the chief himself.

There is a type of man by no means uncommon whom it is policy to suggest the converse of a desirable end. He is certain to act opposite to his subordinate who thereby obtains his end.

Right handling of superiors is an asset of value to a subordinate who is too often told he is hired to do, not to think. Small wonder if he learn wisdom in course of time and find silence is golden.

A good chief is one who can get the most original thinking out of his staff. The wrong attitude is fostered where the chief is incapable of taking advice even when he solicits it himself.

It must be remembered that it needs courage and assurance to contradict a superior and to be assessed as a carping critic leads to trouble from aloft more surely than acquiescence in possible mistake. Moreover, the first-rate man is very rarely the dead sure man. After all, the chief may be right, unless there is palpable error in question and one easily substantiated.

The sooner we all realize that all industry, particularly engineering effort, is co-operative, dependent upon each and all in proportion to responsibility, the sooner lots of trouble will be avoided. At present certain men are hired to think and the great majority to obey. If obedience is a virtue (it is catalogued as such) then an order is an order, not to be lightly set aside because an individual realizes that some other method exists. If a man in a responsible position refuses to furnish considered opinion when called upon, it is high time he drew his salary elsewhere. The trouble is that some men in control brook no difference in opinion, however honest it may be in intention, from a subordinate, and unfortunately such men are not rare.

Actually there is a latent danger in a chief too efficient, too capable. Such men prefer to stand alone and there are times when the element of human fallibility operates and causes catastrophe. It is unsafe to centralize too much power. If there is virtue in organization it is that authority can be delegated and counsel obtained.

Confirmation of one's own viewpoint is always agreeable, but lacking reflective apprehension a danger exists where arrogance is patent. After all, the staff of any organization revolves round a central pivot. If the hinge pin likes applause he gets it; if it is known that he is always willing to reason and welcomes divergent viewpoint, paying heed to the counsel he has a right to expect, then fewer mistakes are likely.

The moral is briefly that every subordinate in a responsible capacity should fill a more or less independent orbit. The co-ordinator should be the chief whose personality determines exact relationships, and who gets served most often as he deserves.

SELLING IN CANADA

Now that preparations are being made for post-bellum trade, up to date commercial information is exceptionally valuable. In his report to the British government's Board of Trade, on the trade of Canada for 1916, Mr. C. H. Wickes, H.M. trade commissioner in this Dominion and Newfoundland, not only discusses economic conditions here and analyzes, statistically, United Kingdom trade with Canada, but he gives also some important hints to traders with Canada. He notes that many of our wholesale dealers insist that cheapness is by no means the determining factor in the Canadian market. It gives place to selling capacity and to the tastes and requirements of the ultimate purchaser. "They also complain," says the commissioner, "that United Kingdom travellers are often so engrossed in the superiority of the article they carry as not to realize that intrinsic value is only one factor in the popularity of a commodity; and while the Canadian wholesaler is ready to acknowledge superiority where it exists, he is more concerned to find goods that will sell themselves, and entail little or no education of his selling staff or the general public. Manufacturers should make the article the public require, and follow this by organized distributive effort. It should be understood that United States firms send well-trained salesmen into Canada in large numbers, and, salesmanship being highly developed in the United States, it must be met by selling ability of an equal or higher calibre on the part of United Kingdom manufacturers, particularly by firms wishful to introduce their goods, and also by those who desire to maintain and develop their existing trade."

This is a point upon which too much emphasis cannot be placed. The business of selling on this continent, especially in the United States which does a very large

trade with Canada, has been given much expert attention. The art of salesmanship is being taught in practical courses to their men by a large number of companies. When an American salesman goes out, he is thoroughly posted on his firm's products, having in many cases an intimate knowledge of the factory process. He knows what competition will be met and has a good idea of how to meet it. He is acquainted with objections which may be raised by prospective buyers, and he has excellent replies ready. He knows the methods of doing business in the market in which he sells. He is posted on the financial condition, and the general reputation and even peculiar personal traits of his prospect, before he tries to sell. His head office supports him with adequate office and travelling expenses, and in other ways, an important factor which many United Kingdom firms have not yet recognized. If the American salesman meets an unexpected obstacle, he will do everything possible to remove it. If difficulties are experienced with financing the purchase of a plant by a municipality, for example, the salesman will frequently arrange a conference with his head office, his prospects and a financial house. While salesmanship is now highly developed in the United States and in Canada, still further progress will be made in the next few years. The World's Salesmanship Congress held in the United States every year is a revelation of the time, money and labor expended by business interests of this continent to train and produce the best type of salesmen for this market. Moreover, the training has repaid many times the effort and expense involved.

PERSONALS

H. A. Woods, assistant chief engineer of the Grand Trunk Pacific, has resigned his position.

Omer Arnold has been appointed engineer for the townships of Bastard and Burgess (South), Ont.

W. H. Sample has succeeded W. D. Robb as superintendent of motive power of the Grand Trunk Railway, with headquarters at Montreal.

B. L. Eastman, mining engineer, who has been at the Bluebell Mine, in British Columbia, for some years, has left for the United States, to offer himself for overseas service.

Raould Rinfret, Q.L.S., D.L.S., Mem.Can.Soc. C.E., who has been in the private practice for thirty years, has been engaged by the city of Shawinigan Falls as municipal engineer.

Lieut. Arthur H. Livingstone is reported to be suffering from shell shock. Prior to his enlistment he was an undergraduate of the University of Toronto and attended the School of Practical Science.

Major F. D. Burpee, formerly superintendent, Ottawa Electric Railway, Ottawa, Ont., who went overseas as major in the 207th Battalion, C.E.F., recruited in Ottawa, has been gazetted as a temporary lieutenant in the Canadian Railway Troops.

Charles Blair Gordon, of Montreal, former vice-president of the Imperial Munitions Board, and now representing the Imperial Munitions Ministry in the United States, has been made Knight Commander of the newly founded Order of the British Empire.

Col. J. S. Dennis, assistant to the president of the C.P.R., and president of the Canadian Society of Civil Engineers, who has been working in the United States in connection with enlistments there for the Canadian army, has planned the details of an elaborate scheme for the settlement of the returned soldiers on farms and also in industrial life.

OBITUARIES

J. W. H. Watts, R.C.A., honorary treasurer of the Royal Architectural Institute of Canada since its formation ten years ago, died suddenly on Sunday, August 26th, at his home in Ottawa.

Lieut. H. W. Morris has been reported killed in action. He enlisted at the outbreak of the war with an ammunition corps in Montreal and after some service in the firing line was given a commission, and was also awarded the Military Medal at La Coullotte. Prior to enlisting Lieut. Morris was chief electrical engineer of the Grand Trunk Railway.

ROYAL ARCHITECTURAL INSTITUTE

Alcide Chausse, of Montreal, honorable secretary of the Royal Architectural Institute of Canada, announces that the tenth general annual assembly of the institute will be held in Ottawa, October 1st and 2nd, and that a programme has been prepared which will include matters of interest to every architect in the Dominion. All Canadian architects are invited to the association's meeting, whether members of the institute or not.

CANADIAN PUBLIC HEALTH ASSOCIATION AND STANDARD METHODS OF WATER ANALYSIS

The sixth annual congress of the Canadian Public Health Association will be held in the Normal School, Ottawa, September 27th and 28th.

At the Friday afternoon session of the Laboratory Section Mr. Jos. Race, chairman of the committee on standard methods of water analysis, will present his report.

On the evening of that same day a special meeting will be held under the auspices of the Society of Chemical Industry, for the purpose of discussing standard methods of water analysis. It is proposed to adopt the standard methods that have been prepared by the collaboration of the American Chemical Society, the American Public Health Association, and the Society of Official Agricultural Chemists. These methods are contained in pages 1 to 92 of the "Standard Methods of Water Analysis," as issued by the American Public Health Association, 126 Massachusetts Avenue, Boston, ($1.25 post paid). It is desirable that all should familiarize themselves with these methods before coming to the meeting.

This meeting will be held in the Laurentian Club at 7.45 p.m. and will be preceded by the usual informal dinner at 6.30 p.m.

The Canadian Pacific Railway uses 50,000 telegraph poles every year and over 60,000,000 feet of lumber.

A locomotive, said to be the largest in the world, has been completed by the Baldwin Locomotive Works, Eddystone plant. The engine is for the Virginian Railroad, and has 24 driving wheels and six double cylinders. Its weight is 844,000 pounds, with a tractive power of 160,000.

Coast to Coast

Aurora, Ont.—Subject to the approval of the Ontario Railway and Municipal Board, the York Highway Commission granted the request of the Town Council that the tracks of the Metropolitan Railway within the town limits be moved to the centre of Yonge St. At present the tracks are on the east side of the roadway.

Battleford, Sask.—At a recent meeting of the Town Council, Mr. V. T. Robinson, sanitary engineer, reported that the operations previously authorized in connection with sewage disposal had been carried out, and that the crude sludge had been stopped from going into the river. The hole in the bottom of the intersecting chamber had been repaired so that it could be raked out at intervals. He suggested that a siphon from the septic tank would relieve the situation and the necessity of pumping out the tank so often, as by this means the top two feet of the contents could be removed and spread on the undamaged portion of the filter beds. It was also recommended that the old dam should be removed as soon as possible. The waterworks committee was instructed to carry out Mr. Robinson's suggestions.

British Columbia, Province of.—The present programme of construction in this province, mostly of an industrial nature, involves an expenditure of $56,000,000. Work to the value of nearly $40,000,000 is now in progress or is actually contracted for. Of this total about $27,000,000 represents the newly established shipbuilding industry. The remainder is accounted for by railway terminals, piers and wharves, dredging operations, sewer construction, cold-storage plants, factories, mills, schools, etc. In addition more than $16,000,000 worth of new work is planned.

Calgary, Alta.—The Calgary Municipal Railway Co. is arranging to heat its cars by electricity. It is contended to use electricity only in the early mornings and cool evenings in the autumn, and to augment the coal stoves during the very cold weather in winter. Electric heaters were too expensive when the railway had to pay 2c. per kilowatt hour for power, but now when the city is producing power at ¾c. per kilowatt hour they can be used with advantage.

Chatham, Ont.—Building permits for the first eight months of the year are $47,623 in excess of the total for the same period of last year, the respective totals being $391,472 and $342,849. The returns for August reached $75,300.

Chatham, Ont.—The Industrial Committee of the Board of Trade is negotiating with on American concern in an endeavor to persuade them to decide upon Chatham as a location for their proposed Canadian plant.

Guelph, Ont.—A good roads deputation from the local board of trade visited Batavia, N.Y., for the purpose of inspecting the system of permanent roads there.

Hamilton, Ont.—The following building permits have been issued: Canadian Fastener Co. to erect a manufacturing building at the corner of Sherman and Biggar Avenues, to cost $20,000; Fearman Brothers to erect a warehouse at Park and Wine Streets, to cost $8,000; and the Evel Casket Co. to alter its new premises at the corner of King and Tisdale Streets, to cost $5,000.

Minden, Ont.—A press report states that the project to build a railway into Minden, Ont., has been revived; E. A. Rogers, clerk of the municipality, being interested. The G.T.R. has a line from Lindsay to Haliburton, the nearest point to Minden being at Gelert, about 9 miles off; while the Canadian Northern Ry.—the old Irondale, Bancroft and Ottawa Ry., connecting with the G.T.R. near Kinmount, is about 12 miles off. The country is a difficult one for railway construction.

Montreal, Que.—The directors of the Reade Construction Co., Ltd., have decided to change the location of their head office from Toronto to Montreal.

Ojibway, Ont.—Plans for the erection of the United States Steel Corporation's $20,000,000 plant here, will now be carried forward, according to a statement of Ward B. Perley, vice-president and general manager of the Canadian Steel Corporation, the Canadian subsidiary of the big United States concern. This company was incorporated some three years ago. A tract of land on the St. Clair River, north of Windsor, was purchased, a separate municipality was established, streets were laid out for an ideal town, such as the United States Steel Corporation has at its American plants. Then the war put a temporary stop to construction. The bid for tenders for the construction of a slip and huge concrete and steel docks for the Ojibway Co. was the sign for a renewal of construction, and further plans of the company will now be proceeded with. The plant is well situated, being on the direct water route from the Lake Superior iron mines to the ocean. Hydro-electric power will be available from Niagara.

Ontario, Province of.—The Beaver Abitibi Timber Co., Ltd., Beaver Rd., Buffalo, N.Y., have purchased from the Frederickhouse and Abitibi Timber Co., the limit secured from the Ontario Government, and work will be started at once on construction of camp and rossing plant. New station will also be built at the junction of the Frederickhouse River and National Transcontinental Railway, where sawmill, etc., will be built.

Ottawa, Ont.—Tenders will be received until September 20th by A. Johnston, Deputy Minister of Marine, for the construction of a fog alarm building at Little Metis Light Station, County of Rimouski, Que. Plans, etc., with Department of Marine.

Sarnia, Ont.—The motor generator purchased by the Sarnia Street Railway Co., to generate the power for the line has arrived in the city, and is being installed at the hydro-electric plant in the North End. The outside construction in connection with the installation of hydro in this city is about completed. The work on the line, which will serve the South End manufacturing concerns, the Imperial Oil Co., the Mueller Mfg. Co., the Perfection Co., and other industries, will be commenced shortly.

Scarboro Tp., Ont.—The Hydro-Electric Power Commission notified the Scarboro Township Council when it met on September 10th, that work had been started on a line to go through Birchcliffe, Scarboro Junction and Agincourt. It is hoped to complete the work this fall.

Shawinigan Falls, P.Q.—The Canadian Aloxite Co., a subsidiary of the Carborundum Co., of Niagara Falls, has completed the levelling of their mill site and is actually completing the foundations of three large buildings.

St. Catharines, Ont.—A plan of St. Catharines and the vicinity has just been completed by F. N. Rutherford, engineer and Ontario land surveyor.

St. John, N.B.—Building permits have been issued during 1917 to date to the value of $484,950. During the same period in 1916 the permits issued totalled $343,000.

St. John, N.B.—Plans and specifications for the Dry Lake extension are practically complete and tenders will be called for at an early date.

St. Johns, Nfld.—R. H. Reid, vice-president of the Labrador Pulp and Paper Co., is credited with saying that the undertaking would mean the development of one of the most important water powers in the country, the falls on the Hamilton River are second to those of Niagara. The bonds of the company will not be placed on the market, and the increased capitalization will all be met by private subscription.

Three Rivers, Que.—The city, by a meeting of its council on the 6th of September, has decided to guarantee to L. H. Bacque, bonds for an amount of $50,000, on the condition that he builds a brick factory here.

Toronto, Ont.—The Dominion Wheel and Foundries, 131 Eastern Ave., have had plans drawn for a $5,000 machine shop. They will buy materials and supervise all trades. Brick construction. Work to start at once.

Vancouver, B.C.—The International Chemical Co., Ltd., is now completing the installation of equipment for a potash plant on the Queen Charlotte Islands. The company is controlled by Cleveland and Chicago capital.

Victoria, B.C.—The City Council endorsed the resolution of the Kamloops Chamber of Commerce calling on the Dominion government to develop the iron ore deposits of the province and to establish the iron industry, chiefly because of the present demand for steel for ships and munitions.

Wallaceburg, Ont.—Utilities Board will have plans prepared for hydro substation. Brick construction; cost $10,000. Engineer, L. G. McNeice. Tenders will be called shortly.

Welland, Ont.—Representatives of the Canadian Crocker-Wheeler Co. are installing the first 1,500 kw., 46,000-volt transformer, the total weight of which is 37 tons, in the new municipal sub-station.

Construction News Section

Readers will confer a great favor by sending in news items from time to time. We are particularly eager to get notes regarding engineering work in hand or projected, contracts awarded, changes in staffs, etc.

▲—Denotes an item regarding work advertised in *The Canadian Engineer.*
+—Denotes contract awarded. The names of successful contractors are printed in CAPITALS.

ADDITIONAL TENDERS PENDING

Not Including Those Reported in This Issue

Further information may be had from the issues of *The Canadian Engineer* to which reference is made.

PLACE OF WORK	TENDERS CLOSE	ISSUE OF	PAGE
Cobalt, Ont., installation of telephone system	Sept. 18.	Aug. 30.	48
Lundar, Man., completion of school	Sept. 15.	Aug. 30.	50
Norwood, Ont., bridge construction	Sept. 14.	Sept. 6.	54
Toronto, Ont., stop valves, valve operating pumps, special castings	Oct. 2.	Sept. 6.	56

BRIDGES, ROADS AND STREETS

Calgary, Alta.—The city commissioners decided to construct a temporary bridge across the north channel of the Bow River at Fourth St. W. Estimated cost, $1,200. City engineer, Geo. W. Craig.

Chatham, Ont.—A reinforced concrete pavement will be constructed on Tecumseh Rd., and on Third St. City engineer, J. W. Adams.

Edmonton, Alta.—Provincial Department of Public Works plan erection of a bridge across Red Willow River, two miles west of Halcourt.

Erieau, Ont.—A road will be built from this village by Kent County Council. Superintendent of Roads, L. A. Pardo, Chatham.

Ingersoll, Ont.—A pavement may be laid on Charles St. Town clerk, W. R. Smith.

Listowel, Ont.—Town Council decided to extend the reinforced concrete road. Town clerk, Wm. Bright.

+—Oakville, Ont.—The contract for building the Tansley bridge has been given to NORMAN McLEOD of Toronto at $60,000. The bridge will be over 600 feet long, and the floor 18 feet wide. A. W. Connor, of Toronto, is the engineer.

Ottawa, Ont.—City Council plans construction of pavement on Wurtemburg St., from Clarence to St. Patrick. Commissioner of Works, A. F. Macallum.

Peterboro, Ont.—A new sidewalk may be constructed on part of Burnham St.

Peterboro, Ont.—City Council intends to construct a cement sidewalk on both sides of Sutherland Place, west from Rogers St. to the end of Sutherland Place. City engineer, R. H. Parsons.

Quebec, Province of.—Hon. J. A. Tessier, Minister of Highways, will secure estimate of cost for the construction of a road joining St. Gregoire, Montmorency to Giffard.

Sandwich West Tp., Ont.—Township Council plans paving Bridge Ave. About $19,950. E. Bondy, township clerk.

+—Shawinigan Falls, Que.—City Council awarded contracts for the construction of a portion of the city's 5 ft. sidewalks as follows: To NAPOLEON LAPOINTE, 2,500 feet, at $2.50 per square yard; to OVILA RICARD, 2,300 feet, at $2.30; and to ALBERT GIGUERE, 2,000 feet, at $2.35 per square yard.

+—Shawinigan Falls, P.Q.—City Council awarded contract for the grading of the La Grande route, to J. D. JACOB, of Shawinigan Falls, for the bulk sum of $18,120, grading to be done this fall and the concrete surfacing to be done next spring.

St, Catharines, Ont.—Works Committee recommended construction of a bitulithic pavement, concrete curbs and gutter on St. Paul St., from Ontario St. to the Burgoyne Bridge. City engineer, W. P. Near.

+—St. Hyacinthe, Que.—Council let contract to BERNARD BRAULT, Bank of Toronto Building, Maisonneuve, for construction of concrete and asphalt pavement, at $136,000. City engineer, L. A. Ste Marie.

St. John, N.B.—An asphalt sidewalk will be laid on Protection St., west side.

+—St. Pierre, Que.—Town Council let contract to QUINLAN & ROBERTSON, LTD., 260 St. James St., Montreal, for construction of pavement and sidewalks.

St. Thomas, Ont.—The gravel road between St. Thomas and Aylmer will be repaired by Elgin County Council. Engineers, Jas. Bill and Son, St. Thomas.

+—Thorold, Ont.—Town Council let contract to SIDNEY CLARK, for construction of cement walks.

+—Three Rivers, Que.—DALLAIRE & POTHIER, care city engineer, Z. Lambert, have been awarded the contract for laying 12,000 cubic yards of concrete pavement. Cost, $33,600.

Three Rivers, Que.—Tenders are being called for the surfacing with gravel and concrete of a highway from Three Rivers to Grand Mere, a distance of about three miles.

Tillsonburg, Ont.—Work on steel bridge for the G.T.R. will be done by company's men. Superintendent, Mr. Foster, London, Ont.

Toronto, Ont.—City plans to pave Dundas St., from Ossington Ave. to Lansdowne Ave., asphalt. About $70,000.

+—Toronto, Ont.—Contract for constructing bridges has been awarded to ONTARIO BRIDGE CO., LTD., Crown Office Building, Toronto, at $35,000.

+—Wellesley, Ont.—G. G. REID, of Toronto, has been awarded the contract to build two abutments to the county bridge, two miles west of St. Jacob's, over the Conestogo River, and two abutments to the bridge which crosses the Grand River at West Montrose. The contract price is $2,800.

Wingham Tp., Ont.—Township Council is having plans prepared for steel bridge of 50 feet span. Engineer, Guy R Marston, Simcoe, Ont.

WATER, SEWAGE AND REFUSE

Chatham, Ont.—City Council will construct a glazed tile sewer on Pine St. City engineer, J. W. Adams.

+—Cobalt, Ont.—Contract let to the TURBINE EQUIPMENT CO., LTD., Toronto, for one motor-driven multi-stage DeLaval pump, for operating against 400-foot head, by the Mining Corporation of Canada, Cobalt.

Crowland Tp., Ont.—Township Council plans waterworks extension. Clerk, H. L. Pratt, Welland, Ont. Three thousand feet of 10-inch cast iron pipe will be required.

Dereham Tp., Ont.—Township Council proposes to lay tile drain. Secretary-treasurer, Alex. Bell, Mount Elgin, Ont.

Aylmer, Ont.—Carnation Milk Products Co., Ltd., will soon let contract for reservoir. About $25,000. W. H. Robinson, Aylmer, engineer.

Burlington, Ont.—City having plans prepared for new sewers, by P. Dawson, engineer. About $50,000.

Halifax, N.S.—City plans sewer extensions. About $12,000. F. W. W. Doane, city engineer.

London, Ont.—City having plans prepared for sewerage pumping plant at West London. About $50,000. H. Brazier, city engineer.

+—London, Ont.—The City Council awarded contract for construction of storm sewers on Maitland St. to the WEBSTER CONSTRUCTION CO. Cost, $7,000.

+—Macleod, Alta.—Contract has been let to GORMAN, CLANCEY & GRINDLEY, LTD., Calgary, for one American Well Works motor-driven centrifugal pump for main pumping station.

+—Moose Jaw, Sask.—Contract has been let to GORMAN, CLANCEY & GRINDLEY, LTD., Calgary, for three American Well Works motor-driven centrifugal pumps, for Rosedale pumping station, Moose Jaw.

+—New Liskeard, Ont.—Contract let to the TURBINE EQUIPMENT CO., LTD., Toronto, by the Casey-Cobalt Silver Mining Co., for a unit for operating against 450 foot head.

New Toronto, Ont.—The Council may decide to purchase an electrical centrifugal pump.

+—Outremont, Que.—ARTHUR BASTEIN, 372 Ave. de l'Epee, has been awarded the general contract for filtration plant by the municipal council. Reinforced concrete and brick construction. Engineer, J. A. Roy, 23-16th St. Lachine.

+—Point Claire, P.Q.—Contract awarded to the TURBINE EQUIPMENT CO., LTD., Toronto, for two motor-driven DeLaval single-stage pumps, for the filtration plant.

Sarnia, Ont.—City plans to install incinerator. About $25,000. J. A. Baird, city engineer.

St. Catharines, Ont.—City Engineer W. P. Near will secure prices on 3,320 feet of 8-inch wood stave pipe, motors, pumps and fittings for the pumping plant of the Facer St. sewer system.

St. Catharines, Ont.—City plans to build sewer in portions Frazer St. W. P. Near, city engineer.

St. John, N.B.—Tenders to be called soon for extension to waterworks. Work includes laying of 5,000 feet of pipe.

Trail, B.C.—City Council will construct a 14-inch conduit pipe line at Violin Lake. City clerk, W. E. B. Moneypenny.

Trenton, Ont.—By-law is contemplated to issue bonds to the amount of $20,000 to purchase waterworks system from Hydro-Electric.

Vancouver, B.C.—City will construct about one mile of sewer.

Victoria, B.C.—Department of Lands plans to install system of irrigation to be fed by pipe line 27 miles up north fork of Kettle River to reclaim 3,000 acres of land in Grand Fork Valley. About $500,000.

LIGHT, HEAT AND POWER

Alviston, Ont.—Estimates of the cost per horse-power at which power can be supplied to Alviston have been forwarded to this municipality for its consideration.

Aylmer, Ont.—The material necessary for remodelling and extending the Aylmer distributing system has been ordered and a 13,200-volt line will be constructed from St. Thomas to Aylmer. Tenders are also being secured on motor-driven pumps for domestic and fire purposes.

Barton Tp., Ont.—The Barton Township Council has decided to submit Hydro-Electric and enabling by-laws to the ratepayers in this township, and the work of preparing estimates to determine the amount of the money by-laws is now under way.

Bedford, P.Q.—The Bedford Light Co., Ltd., will construct dam across Pike River by day labor. Secretary, C. O. Jones.

Brantford Tp., Ont.—The Hydro-Electric enabling by-law and the money by-law were submitted to the ratepayers in Brantford township in districts immediately adjoining the city of Brantford, as canvassed by the council, and both were carried. The money by-law was for the amount of $27,000, to cover the cost of purchasing the lines and system of the Western Counties Electric Company, and extending and remodelling these lines.

Brussels, Ont.—It is proposed to run a hydro line through this district from Eugenia Falls.

Dashwood, Ont.—The work of building a distributing system in Dashwood under the supervision of the Commission's engineers is now under way, and it is expected that power will be turned on in this municipality very soon.

Drayton, Ont.—The Hydro-Electric enabling and money by-laws were submitted to the ratepayers and were both carried by large majorities. Arrangements are being made by the municipality to purchase the local system, which will be remodelled and extended to make it suitable for Hydro-Electric power. Material is being ordered for the 4,000-volt transmission line to supply this municipality.

+—Drummondville, Que.—The Southern Canada Power Co. have awarded a contract for a 400-h.p. single vertical turbine to the S. MORGAN SMITH CO.

Melita, Man.—On September 15th by-law will be submitted to issue debentures for $10,000 for street lighting system. Clerk, W. F. Thomas.

Mitchell, Ont.—The electric light plant at Brussels has been purchased by S. Wilton for $3,500.

Oil Springs, Ont.—The construction of a distributing system in Oil Springs will be started within the next few days.

Rosthern, Sask.—The town will install a 50-k.w. gas engine and generator, and switchboard, etc.

St. Thomas, Ont.—The Hydro-Electric Commission and the Council have reached a tentative arrangement for the improvement of the lighting system on Ross Street, St. Catherine Street and Wilson Avenue. The cost of the change from the old plan will reach some thousands of dollars, and will be borne by the Commission.

Thessalon, Ont.—The Hydro-Electric Power Commission of Ontario are investigating the possibilities of power development in the vicinity of Thessalon, Ont. The sites examined included Halcombe's Mill, Little Rapids, McCreight Dam, Tunnel Bridge, Grand Falls, Slate Falls, Day Milles, Mill town and Ansonia. An ample supply of power, it is anticipated, would bring to Thessalon many new industries.

Vancouver, B.C.—The United Water Power Companies, Ltd., has been incorporated. Head office, Vancouver. Capital, $32,000.

Zurich, Ont.—The work of building a distribution system in Zurich will be started immediately. The 4,000-volt line, built from Exeter to supply power to Dashwood and Zurich, is almost completed, and it is expected that power will be supplied to the village this month.

RAILWAYS

Calgary, Alta.—A spur track will be run from the Sunnyside line of the street railway. About 1,600 feet of rails will be needed. City engineer, Geo. W. Craig.

Calgary, Alta.—City Commissioners considering construction of a spur to the Roberts building on Eleventh Ave.

Minden, Ont.—Negotiations are in progress regarding the construction of the Minden Electric Railway through the Norland district. A preliminary survey has been made through Minden to Mountain Lake and estimates are being prepared as to cost.

Ojibway, Ont.—The Dominion Parliament has authorized the Essex Terminal Railway Co. to build a branch line from its existing line near Ojibway to Pelton, Ont., seven miles.

FACTORIES AND LARGE BUILDINGS

Barrie, Ont.—Public School Board has invited competitive plans for $60,000 collegiate institute. Secretary, Fred. Marr.

Bathurst, N.B.—Tenders will be received up to September 15th, for erection of college for Sacred Heart College. Brick construction; estimated cost, $250,000. R. A. Frechette, 30 Bonnacord St., Moncton, N.B., architect.