PAGES

MISSING

The Canadian Engineer

An Engineering Weekly.

METHODS AND COSTS OF CLEANING WATER MAINS.

The cleaning of water mains is a matter of much interest to the engineer engaged on municipal work. The following article by F. Osborne Redford, which appeared in a recent issue of Engineering and Contracting, gives the methods and costs on certain work of this kind.

The writer of this article was formerly employed with the original water main cleaning company in the United States and during the spring of 1909 resigned and promoted the American Water Main Cleaning & Contracting Company of Louisville, Ky., and during the summer of 1909 cleaned some 15 miles of 3, 4, and 6-in. water pipe. Some of the mains had been laid for 40 years, yet little difficulty was encountered in restoring them to their original inside diameter.

Fig. 1 shows the form of water main cleaner invented by the writer. The form of construction of this cleaner shows its adaptability for this class of work. It cleans all foreign matter out of the main and leaves no part of the inner surface of the pipe untouched. The machine is designed similar to a flue cleaner, having a piston at each end to support the spring straps which are screwed to the pistons, on which are screwed scrapers or cutters that bear against the inner surface of the main and remove the tuberculation. After the machine is assembled, leaving out the connecting rod, it is put on a universal grinder, on centers and the cutters are ground to exactly the size of pipe the cleaner is designed to clean. After this is done the spiral spring is placed in the socket in rear piston, the piston being bored about half way through so as to allow the spring to press against the seat, and extend about 1 in. outside of the piston. The connecting rod is then screwed into the front piston until the collar on the rod meets the spring. If it is desired that the machine be increased in size ¼ in. the connecting rod is unscrewed and the machine expands. After the machine has been set to the desired size a little set screw is put into place in the rear piston, being screwed into key seat in the connecting rod to keep the machine from coming apart while going through the main. The pistons used in these machines were made of bronze and drop-forgings, the front piston being made of the latter. Usually three of these machines are connected together, so if any part becomes broken the other can take up its work.

In case the machine comes in contact with a corporation cock while going through the main, it immediately reduces its diameter by means of the spiral spring in the rear piston, while as soon as it has passed it retains its former size.

It has been our experience that when this machine comes in contact with a piece of lead in the water mains where a poor joint has been made by the calker by allowing the lead to run into the main, which retards the progress of the water to a certain extent, the machine will cut its way through the lead, leaving a smooth bore without damaging the joint. In such cases the lead usually will be caught on the scrapers. We have brought pieces of lead out of the mains weighing twenty-five pounds, which had been poured in by some careless calker. With a machine of this design the diameter can be increased from ¼ to ¾ in. depending upon the hardness of the incrustation to be removed. The scrapers are set at an angle so they will overlap each other, allowing no part of the pipe to remain untouched, and furthermore to allow the machine to pass the joints safely without dropping in and tearing away the joint lead and possibly breaking the cutters.

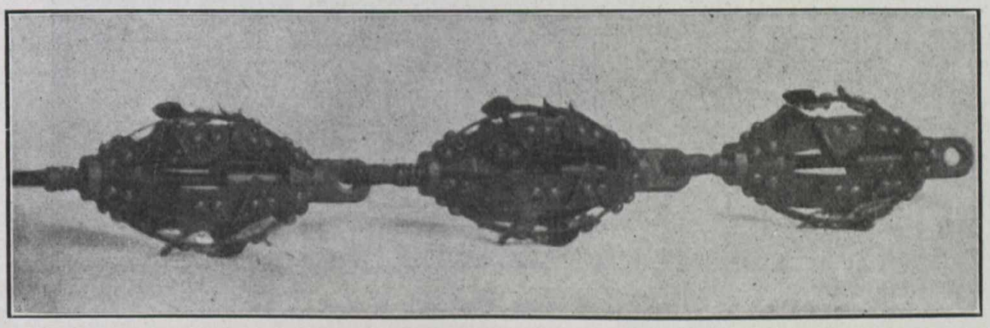


Fig. 1.—Form of Water Main Cleaner.

The machine used for cleaning larger size pipe such as 8-in. and over is of similar design, with a double plunger in the rear so as to propel the machine with water power, thereby doing away with the cable used with the smaller type of machine. We used a double plunger for the reason that in passing a main larger than the one we are cleaning, the machine would stop at the cross, and allow the water to pass the machine, whereas with a double plunger, one set about 2 ft. apart depending upon the crosses we pass, we are able to get the front plunger past the cross, while the rear plunger is still on the other side. Then the pressure of the water behind the front plunger will force the machine past the cross without stopping. The larger machines are usually made of two sections and a plunger. The sections are connected with a joint that can be made rigid when a straight line of pipe is to be cleaned, and flexible when curved sections of pipe are encountered. There are four rods with ball and socket joints where the machine connect. These rods are screwed into the plunger and connect into a plate in the front of the machine into which a hook is screwed which engages the front hook of the machine. As a result of this arrangement the force of the water against the plunger pushes the machine and at the same time pulls it and keeps it from becoming cramped in the main. The rear plunger is fitted with valves, similar to the damper in an ordinary stovepipe, by means of which water is permitted to pass the machine. The amount of water so by-passed depends upon the available working pressure of the water in the mains.

Method of Cleaning Four-inch Mains.

In cleaning 4-in. mains the first step is to uncover the pipe at certain chosen points. The excavation at such a point is usually about 2 ft. wide by 6 ft. long, and is carried down 1 ft. below the bottom of the pipe. The excavation below the pipe forms the bell-hoile which affords room for the calker to swing his hammer in making up the joints. The pit drains to a pump hole in one corner. This keeps the opening dry and allows the calker to make a good joint after the cable is passed through the main. The openings are usually about 350 ft. apart on 3-in. and 4-in. mains. In pipes of this size the cable is passed through the mains by rods similar to sewer rods.

After the openings have been excavated the consumers are notified that the water will be turned off in the neighborhood drawing from the main to be cleaned. About two hours' notice usually is given before putting the line out of service. As soon as the water is shut off the pipe is cut in the excavation nearest to the gate valve. On 4-in. mains a section of pipe about 2½ ft. long is generally so removed at each excavation. About 1,200 ft. is the usual length of pipe cleared at one draw for this diameter.

cord and passed through the piece of pipe which is to be calked into the line at that point. The cable is again attached to the cord and is pulled to the next opening toward the gate valve where it is again freed from the cord and passed through a piece of pipe of the proper length to seal the opening. This process is repeated until the opening at the gate is reached where the cord is loosened and dispensed with. The cable is attached to the machine which is pulled far enough into the pipe line to allow the calker to fit in and calk a piece of pipe to seal the line at that point. Watertight joints are then made at all the intermediate openings and the only opening in the line is then the one at the distant end where the heavy winch was located. It will be remembered that a 45° bend was calked into the line at that point. A riser pipe is calked to the bend so that the washings are carried up out of the trench and discharged into the gutter. A piece of string is tied around the cable at the point where it leaves the riser pipe before beginning the scraping operations. By this means it is easy to locate the machine in case it breaks away from the cable in coming through the pipe.

The gate valve back of the machine is then opened, and the water is allowed to run through the pipe until a full stream comes out of the riser pipe. The operators then start to wind up the cable on the large winch and the machine is drawn through the pipe. The loosened foreign matter of all kinds is washed out through the riser pipe. The machine

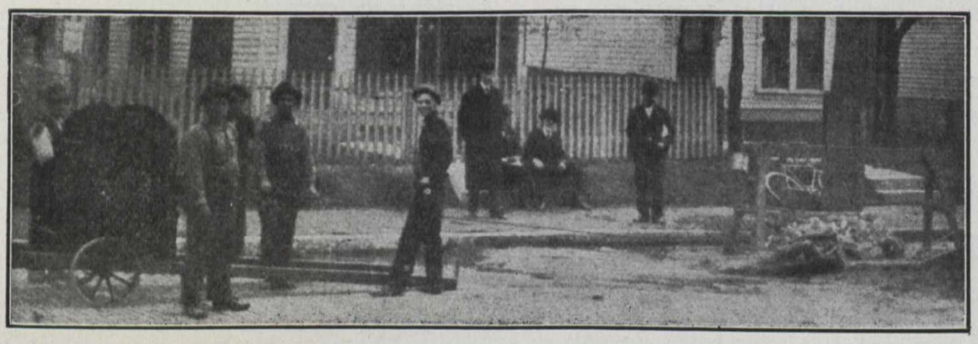


Fig. 2.—Method of Drawing Cleaner Through Small Water Mains.

As soon as the sections of pipe have been removed and the water pumped out of the excavations, half-inch rods are passed through the pipe line. The rods are introduced in short sections beginning at the opening near the gate valve. The last rod forced in has a hook on its free end to which No. 27 bright cord is attached. This cord is reeled off of a small hand winch which is placed directly over the excavation. The winch is supported by a frame which is easily taken apart for shipment from one job to another.

The rods are forced through the main by means of a roding device invented by the writer. As fast as the rods reach each opening in turn, the roding device is removed to that opening and the rods are forced on to the next opening. When the last opening, at the end of the 1,200 ft. of main, is reached the bright cord is attached to the ½-in. steel cable which is used to pull the machine through the pipe. The ½-in. cable is passed through a 45° bend, and attached riser pipe, before it is attached to the bright cord, and the bend is then calked into the opening. The steel cable is wound around a heavy, braced winch which is firmly anchored over the excavation farthest from the controlling gate valve.

The cable and cord are pulled back through the pipe by means of the small winch at the gate end. As the end of the cable reaches each excavation it is unfastened from the

usually is drawn through the pipe line at the rate of 20 feet per minute. The manner of pulling the cable through the pipe by means of the large, anchored winch is clearly shown by Fig. 2. The water is allowed to escape in this manner until it flows clear. The 45° bend is then removed and the open ends of the pipe are plugged. A jack is screwed up tight between the plugs and left there over night. The next morning the jack is removed, the plugs knocked out, and the work proceeds in the manner described.

Cost of Cleaning Four-inch Mains in Louisville.

The cost of cleaning 4-in. mains for the Louisville Water Company is given below. These costs are for the work done from June 2 to June 12 inclusive, 1909. These dates are selected because at that time the most troublesome section of the city mains were being cleaned. During these eleven days 7,937 ft. of 4-in. mains were cleaned at a contract price for all labor and material of 7 cents per ft. The total cost to the city was, therefore, $555.59.

Actual Cost.—The actual cost of labor and material used in this job was as follows:

42 4-in. sleeves	$ 55.88
63 ft. 4-in. pipe	18.26
Yarn	0.60
Lead	12.00
Cement	8.00

Sand	0.65
Labor	162.99
Teams	32.00
Overhead charges	44.69
Total actual cost	$335.07
Actual cost per ft., 4¼ cts.	

The character of mud and incrustation encountered on this section of 4-in. pipe is shown in Fig. 3. It will be noted that the main was nearly closed. The deposit in this section of the city was mostly a yellow mud from the Ohio, with just a very thin scale of incrustation at the bottom of the main. The capacity of this main was increased 550 per cent. by cleaning.

Method of Cleaning Six-inch Pipe.

The method used in cleaning 6-in. pipe differs from the one described for cleaning 4-in. pipe chiefly in the manner of getting the cable through the main. Six-inch pipe can be cleaned at less cost, usually, than 4-in.

The consumers are notified, as before, and gates are closed to put the line out of service. In cleaning 6-in. pipe about 1,600 ft. makes a good draw. The opening at the large winch is first cut and about 3 ft. of pipe is removed. A 45° bend, with riser pipe attached, is calked on. The end next to the controlling gate is then cut, the water is pumped out of the trench, and the 3-ft. section of pipe is removed. The small winch, on which the small bright cord is wound, is placed over this opening. A leather carrier is used to pass the cord through the main instead of the rods heretofore described. This carrier preferably is made of a roll of leather just a little smaller in diameter than the pipe. A cup is sewed to the front end of the roll to prevent water from passing through it. A strong steel band is fastened to the rear end of the carrier to which is fastened the bright cord. A hatch box designed for use in subsequent cleanings of the main is placed in this opening next to the gate valve. The cover of the box can be removed during the cleaning operations and this saves repeated cutting of the main. A piece of pipe about 2 ft. long and large enough to receive the small cord is screwed into the removable cover of the hatch box. The cord is passed over a small reel, mounted in the hatch box, while it is going through the main attached to the carrier. This holds the cord in the centre of the pipe. After the cord is attached to the carrier, the hatch box is placed in the line. The hatch box has one bell and one spigot end. A sleeve is placed over the spigot end and the hatch box is calked into the line by means of watertight yarn joints. After this is done the gate is opened and the water comes in back of the carrier and pushes it through the 1,600 ft. of main in three minutes, more or less, depending upon the amount of incrustation present and the pressure on the line. As soon as the carrier reaches the end of the line of pipe to be cleaned it is detached from the cord. The cable is attached to the cord and pulled back to the hatch box by means of the small winch. This usually takes about one-half hour. The sleeve of the hatch box is then driven off and the box removed. The water was shut off, of course, when the carrier was removed. The 6-in. cleaner is then attached to the cable and is drawn into the pipe line. After the joints near the gate are again made up the gate is opened and the machine driven through the pipe as in the case of the work on the 4-in. line already described.

Patented metallic carriers have been used, but they are not as satisfactory as the roll of leather described. The long tube of leather should be so designed and cut as to bear only at each end, the middle not touching the pipe at all. It will then go around any curve in the line and is readily withdrawn if it gets stuck. Metallic cup carriers are hard to draw back if they get jammed.

In one case a hydrant located on 1,115 ft. of 6-in. main threw water only 2 ft. before the main was cleaned. After 2 cu. yds. of incrustation had been removed by the machinery and methods described in this article the hydrant threw water a distance of 37 ft. from the opened hose connection.

Cost of Cleaning Six-inch Water Mains in Louisville.

The contract price for cleaning the 6-in. main on 9,183 ft. of main for labor and material, was 8 cts. per foot. The total contract price was $734.64. On this work the small cord was carried through the mains by means of the carrier.

Actual Cost.—The actual cost for labor and material was as follows:

33 6-in. sleeves	$ 55.77
9 ft. of 6-in. pipe	3.30
Lead	11.72
Yarn	0.39
Cement	4.60
Sand	0.60
Labor	131.69
Teaming	24.00
Overhead charges	28.00
Total actual cost	$260.07
Atual cost per ft., 2.83 cts.	

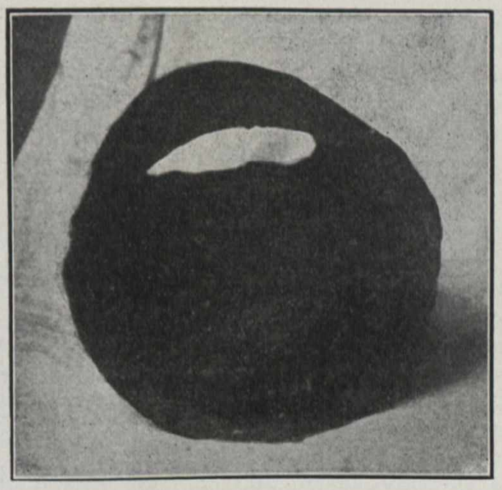


Fig. 3.—Section of Six-inch Water Main Before Cleaning, Louisville, Ky.

The writer also cleaned water mains in Middletown, Pa., for the Middletown Sawtara Consolidated Water Co., and found the cost of the work there about the same as in Louisville. The writer knew of one case in the East where about five miles of 20-in. main was cleaned at a contract price of 60 cts. per ft. This price was exhorbitant. As a matter of fact the entire five miles of pipe were cleaned in about two weeks at a total cost not exceeding $1,500. It has been the writer's observation that such exhorbitant prices have kept many water companies from cleaning their mains by contract. Although the writer has sold his patents and is no longer in the water mains cleaning business he will be glad to answer questions without charge relating to the manner of doing the work, and will make sketches of the machinery to be used. It is the judgment of the writer that water companies would save a great deal of money by cleaning their own mains.

THE PRODUCTION AND USE OF PEAT FUEL.

In a lecture delivered before the Modern Science Club of Brooklyn, N.Y., Mr. A. R. Maujer, of New York, remarked that peat is a combustible substance produced under certain conditions by the slow decay of vegetable matter. The character of peat depends upon the condition prevailing during this decay and on the nature of the vegetation from which it is formed. To the peat-forming vegetation belong nearly all of the mosses, heath plants, water and swamp plants, such as rushes, sedges and grasses, trunks and roots of trees, etc.

In order that slow decomposition may take place, free access of air to the dead vegetation must be prevented, else oxidation will accompany the decay and ultimately only inorganic substances will remain. Peat bogs are most prevalent in lowland districts, but they may occur in mountainous countries when drainage is impeded so as to form local accumulations of water.

Humidity is a very important regulator of the distribution of bogs. Wooded moors favor the growth of mosses, owing to the air there being more moist than in the open country. Hence it is that the bogs in low-lying areas seldom have trees buried in them, whereas in mountain bogs trees are plentiful, the growth of the moss being favored by the fallen trunks damming back the water so as to form pools.

The different classes of peat are divided into two large groups—moss peat and grass peat. The chief products from moss peat are, litter or live stock bedding, paper, filling and packing materials, insulating material, alcohol, fertilizer and in some cases, fuel, although from its porous nature, it is bulky, especially difficult to dry and if handled dry, falls to pieces easily.

The grass peats make the best fuel. They are heavy and compact and dry with comparative rapidity. As a fuel, peat from its nature may be classified between wood and lignite.

Peat is found in practically all parts of the world but particularly in the temperate zone. Holland has been using peat as fuel for centuries. Her present yearly consumption is something over a million tons. Russia produces over four million tons annually. It is estimated that there are upward of 11,000 square miles of peat bogs in the United States, exclusive of Alaska. In Canada an estimate based on a survey which is only partially complete, places the bog area there at over 37,000 square miles.

Among the factors which have prevented the growth of a successful peat-fuel industry on this continent are:—

(1) Lack of knowledge of the characteristics of peat.

(2) Lack of suitable machinery to handle same.

(3) High cost of labor as compared with European conditions.

(4) Low cost and abundance of other fuels, such as coal and wood.

Peat is a fuel of low calorific value, averaging from 6,000 to 9,000 B. t. u. per pound of dry substance, one pound of good coal is equal to 1⅓ to 2 pounds of average peat. Although peat when burned under a boiler will generate steam, the quantity required is nearly twice that of coal, so that a larger grate area is required and the fuel must be more frequently fired. The ashes are light and can easily be removed. The flame is long and should put the heat where it will do the most good, in the tubes. From its light and pulverent nature, when the draft is forced, considerable fuel might find its way into the stack before complete combustion.

An important factor is that of the time required to dry the peat. This varies with the extremes and middle of the season, setbacks by rains, heavy dews, and possible frosts; on the average peat properly laid out may reach the necessary degree of dryness in from two to there weeks, if it is not spread too thickly.

One acre of drying ground carried to a depth of 4 inches would contain 453 tons of fresh peat having 90% of moisture, or 68 tons of air-dried peat of 33% moisture. The acre of drying ground would be covered 9 times in six months, and the fuel produced per acre per season, that is for the year, would be a little over 600 tons.

By his calculation a plant using 1,000 h.p. requires 36 tons of peat per day or 13,140 tons per year. This output would necessitate 22 acres of drying ground.

Two methods of removing water from peat are often advocated, pressing the water out and evaporating it by artificial heat. The speaker did not earnestly advocate the use of peat presses, but such, when being considered, should possess continuous and rapid operation, great strength, and screens that will not clog up and yet will hold the peat from passing through.

As half a year's fuel must be stored for the winter, it is evident that the storage plant must be quite large on account of the amount stored and its bulky nature. For the plant delivering an average of 1,000 horse power continuously, about 6,500 tons must be stored, and as a cubic foot of peat fuel weighs about 25 pounds, the volume occupied by 6,500 tons is about 520,000 cubic feet.

By using machinery, peat fuel ought to be manufactured for $1 per ton or less. If so, it can compete with coal at $2 a ton.

The coal deposits of Canada are all located in the western and eastern portions of the country; practically no coal is found in the central parts. The anthracite which is used in the central provinces is obtained from the Pennsylvania districts. Because of expense of transporting it such a great distance the cost is high. In Ontario and Quebec anthracite of very ordinary grade costs $7.50 per ton; in Manitoba the cost is as high as $10. For these reasons a satisfactory substitute for coal which could be made to compete with it commercially would find a ready market, and the Canadian Government, recognizing the economic possibilities in a thriving peat-fuel industry, is endeavoring to stimulate the interest and enterprise of bog owners and manufacturers by demonstrating that peat fuel can be produced cheaply and that power for industrial purposes as well as heat for domestic use can be obtained therefrom. To accomplish this a portion, comprising about 300 acres, of what is known as the Alfred bog has been acquired and fuel is being manufactured. The peat is used at the Canadian Government's fuel-testing station in a peat producer-gas plant of 60 horse power capacity. The bog is situated about 40 miles east of Ottawa in Prescott County, Province of Ontario. It covers an area of approximately 6,800 acres. The peat varies in depth from 3 to 17 feet. That the peat of the Alfred bog is suitable for fuel is shown by the analysis which was obtained from Bulletin No. 4, issued by the Canadian Department of Mines.

Analysis of Peat from Alfred Bog. Absolutely Dry.

	Per cent.
Volatile matter	68.23
Fixed carbon	26.00
Ash	5.77
Nitrogen	1.76
Sulphur	0.218
Phosphorous	0.033
Calorific value in B. t. u.	9005

Before actual manufacturing operations were started at the Government bog about 24,000 linear feet of drainage ditches were run late in the summer of 1909. This required the excavation of about 9,300 cubic yards. The excavating was done entirely by hand and cost approximately 8½ cents per cubic yard.

The Canadian Government will keep all of the peat that it requires for testing purposes and sell the rest at a suitable price.

The fuel testing station is located in Ottawa. It was erected during the summer of 1909. At present the plant is equipped for testing peat fuel only. The apparatus consists of a Körting double-zone suction gas producer, the necessary purifying apparatus, a Körting gas engine and a 50 kilowatt Westinghouse direct current generator. The producer room is large enough to hold additional apparatus and producers of other types are to be installed in the near future. These producers will be especially designed for bituminous coals and lignites. The producer is 15 feet high, 2 feet 9 inches wide and 5 feet long. The gas-cleansing apparatus is at the right of the producer. This consists of a wet tar separator and a coke scrubber.

The engine is a single-cylinder four-stroke-cycle machine, fitted with a throttling governor. The diameter of the cylinder is 15 inches and the stroke is 24 inches. The speed is 200 revolutions per minute. The air supply for the engine is obtained from the interior of the engine room through a brick duct built against the wall of the engine room. With this arrangement the temperature of the air supply remains practically constant throughout the year. During tests, the current generated by the dynamo is absorbed by either the bank of 500 16-candlepower incandescent lamps which is located on the end wall of the engine room or by an iron grid against the wall.

When the producer is started up, suction is furnished by a small centrifugal exhauster belted to an alternating current motor. The engine is started with compressed air.

The gas-testing apparatus is located on the right wall of the engine room. Gas is drawn from the system by a small Root blower and passed through a Junker gas meter. From the meter the gas goes to a calorimeter which is also a Junker instrument. The average effective heat value of the gas is about 126 B. t. u. per cubic foot. The producer requires from 2½ to 3 pounds of peat per brake horse power per hour. The plant has been in actual operation for such a short time that no specific data in regard to the cost of operation and the performance of the apparatus are available.

PANAMA CANAL SCRAP.

Eleven bidders have competed for the scrap metal, relics of the machinery used by French Panama Canal Company in its attempt to dig a canal across the isthmus, and which the United States government wishes to clear away before the waterway is completed. The highest bids came from the Chicago House Wrecking Company, of Chicago, ranging from $215,000 to $700,000, and the Phoenix Iron and Steel Company, of Galveston, Texas, $66,250 to $246,250. The successful bidder must remove it within three years.

MODERN HEATING PRACTICE.

Konrad Meier.

(Continued from last week).

Direct-indirect heating, with the air inlets back of radiators, is also adversely affected by wind and weather, giving less air when most is needed. Proper control of temperature becomes almost impossible without shutting the inlets, which is the usual fate of these devices. A more satisfactory solution in some cases may be found in the use of very small sash ventilators, admitting fresh air directly, in as many places as possible, deflecting and diffusing it, and thus keeping the room air sweeter and cooler, with comfort depending on the radiant heat provided.

In general, radiant heat is best applied by hot-water radiation, which has an average temperature of only 130 deg. to 140 deg. and is rarely unpleasant. With steam-heaters, the radiation is usually too intense and too concentrated, and should be modified by greater division of surface.

Hygiene in Ventilating.

One cannot discuss hygiene in heating without touching on the same principles as applied to modern ventilating apparatus. Even though each should act independently, one may spoil the result of the other, hence they must be treated in harmony. The first point to be borne in mind when designing ventilating apparatus, more especially an air-supply system, is again salubrity. This must not only be made possible, or probable, but compulsory or automatic, inasmuch as the air passages are necessarily out of sight and therefore only too apt to be neglected. In order to prevent dead spaces, which form eddies in the current and create dust pockets, smooth clean metal or tile ducts should lead directly from outdoors to the tempering surfaces and fans, and from the same to the flues and registers. All the passages should be of sizes to assure a fair velocity of the air current that will not allow any accumulation of dust and foreign matter at any point, from intake to room. Tempering surfaces should also be spaced for a fair speed, and should be of the kind that will present a smooth surface, completely swept by the air current. The entire system in fact should be designed with the idea of sweeping itself, or making it "clean as a whistle." This is recommended not only with the idea of avoiding all possible contamination but also in order to preserve the natural sweetness of the air, which is always destroyed in contact with organic dust stirred up by the unavoidable motion. Moderate temperature of the stacks for warming, higher speed in passing the surfaces, and lowest practicable temperature of the air supply will always tend to preserve its ozone and oxygen, that is, its life and wholesomeness.

The mere capacity of an apparatus to heat, and to effect a certain renewal of air, should no longer be the only criterion of performance. The sanitary requirements must receive equal consideration, if the best results are to be obtained. It will be conceded that the average practice in the planning and installation of apparatus is still deficient in these respects. Indeed, probably the best chances for improvement in this field at the present time may be found in the application of hygiene. In any event, due attention to this subject is more likely than anything else to prevent such extremes as the establishment of open-air schools. It will also tend to overcome the frequent opposition to modern ways of heating and to artificial ventilation on the part of the medical profession, which has no doubt its basis of justification. As a general conclusion it may be stated that the preventive sanitary measures advocated can only increase the efficiency and usefulness of modern installations.

THINGS TO KNOW ABOUT PERMISSIBLE EXPLOSIVES

By CLARENCE HALL, Explosive Engineer, Bureau of Mines, U.S.A.

From September 2, 1908, to June 1, 1911, during which time the gallery for testing explosives has been in operation in Pittsburg, Pa., one hundred and forty-five (145) explosives have been submitted for official tests, eighty-four (84) of which have been passed for use in coal mines under certain provisions. The remainder have either failed to pass the tests or have been withdrawn by the manufacturers when introducing new and improved explosives.

During the year 1909, 8,598,027 pounds of permissible explosives were used in the United States. In the mines of Great Britain there were used, during the same year, 8,502,232 pounds of permitted explosives. For the year 1910 the use of permissible explosives has shown a marked increase in the coal mines of this country. The returns received from the manufacturers indicate that the quantity used during the year 1910 will reach 12,000,000 pounds.

The underlying reasons why one explosive passes and another fails when tested in the presence of gas and dust have been investigated at the testing station. The results of researches made, especially on explosives which failed to pass tests, have been reported to the manufacturers and in nearly all cases resulting in the manufacturers so changing and perfecting their explosives that later when new explosives were submitted they have successfully passed all requirements of the bureau. The results of tests indicate that every explosive if fired in very large quantities will cause ignition of gas and coal dust mixtures. An arbitrary charge; namely, 1½ pounds, has been established as the amount of explosives to be used in making tests, and all explosives, in order to be placed on the permissible list, must pass the gas and dust tests with this charge of explosive. A charge of 1½ pounds per drill hole should never be exceeded in practice. In good mining practice it need not exceed one pound and, accordingly, a greater factor of safety obtains. Explosives of many different compositions are now on the permissible list but all have been formulated with a view to producing explosives which on detonation give a relatively low flame temperature of short duration. It has been found that in order to ignite inflamable gas and coal dust mixtures a certain temperature, acting through a certain length of time, is required. It has also been determined that the temperature on detonation of all explosives exceeds the ignition temperature of inflamable gas and dust mixtures, but fortunately the flame of the permissible explosives is of such short duration when properly detonated that the requisite time necessary for igniting the inflamable mixtures does not obtain. It is evident that any factor that increases the duration of the flame temperature of a permissible explosive, such as the use of a weak detonator or the use of any explosive not in accordance with the provisions prescribed by the Bureau of Mines, will increase the danger in their use.

Encourage Experiments.

The energy developed by the detonation of permissible explosives, like other high explosives, depends on the change of the small solid particles and liquids of the explosive into large volums of gases and the rate of detonation or the rapidity with which these gases are formed. To meet the varying coal mining conditions in this country the manufacturers have formulated explosives in rates of detonation from 1,447 to 4,439 meters (4,746 to 14,560 ft.) per second. It is evident that for certain work where a shattering effect is desired in driving through or bushing rock, or producing coal for coking purposes the explosive reaction should be rapid, and permissible explosives should be selected from the list having a high rate of detonation. In a similar manner a suitable permissible explosive for use in soft friable coal and especially so when lump or steam coal is desired, should be selected which develops its gases at a slow rate in order that the pressure developed will be more prolonged.

I have been informed that the coal operators of West Virginia are overwhelmed with agents of permissible explosives with their various claims of efficiency. To establish their claims it means that their demonstrators must conduct a series of experiments over a considerable period of time in the mines. This procedure should not be discouraged for the reason that the manufacturers are constantly improving their explosives and in many cases permissible explosives which are more suitable to the work have been selected as a result of such tests. However, much of this unnecessary work could be eliminated by careful consideration of the physical characteristics of each explosive before making tests. The chemical composition would be of little value to the operator and it is not proposed to publish such information. In several instances in mining bituminous coal it has been found that permissible explosives containing only 20 per cent. of nitroglycerine have given better results and produced better coal than those made under a similar formula containing 25 per cent. of nitroglycerine. The physical tests of explosives, such as in the gallery, rate of detonation, strengths of explosives as determined bp lead blocks, gauges, ballistic pendulum, height and duration of flame, will be published as Bulletin No. 15 by the Bureau of Mines during the present month. The information will be of value to both the manufacturers and users of explosives.

Points in Hole Charging.

Suppose, for instance, an operator has tried several permissible explosives in a certain mine where the coal is soft and friable and has selected one as the most suitable for the work in question. From this bulletin he will note that the rate of detonation of this explosive is 2,000 meters per second. Now suppose the operator receives a request to try out a new explosive. He should first ascertain the physical characteristics of the new explosive. If he learns that the new explosive has a rate of detonation of 4,000 meters per second it would be obvious that this explosive would be too quick of action and not suitable for this particular coal. It is true a powder man skilled in the use of a quick explosive might possibly in a limited series of tests, through special skill, demonstrate the new explosive to be more economical and at the same time equally efficient as a slower permissible explosive but it should not be expected that the average miner would obtain the same results.

By carefully considering the location of the drill holes and using special conditions in loading and tamping to reduce the pressure developed, a permissible explosive of a high rate of detonation could be successfully used in nearly all coal mines. It is well known that the pressure developed by the detonation of explosives in a closed space is directly proportional to the charging density; that is to say, a 1¾-

inch drill hole loaded with 1¼-inch cartridges will produce about one-half as much pressure per square inch on the walls of the drill holes as it would if loaded with cartridges of 1¾-inch diameter and, accordingly, explosives of a rapid rate of detonation if used in this manner would be productive of a better quality of coal. This procedure of air spacing to reduce the shattering effect is recommended by the Bureau of Mines.

There are other means of reducing the shattering effect of explosives, such as the use of a weak detonator, reducing the amount of steaming used in a drill hole, using explosives that are frozen or partly frozen, using cartridges of explosives of less diameter than were originally tested, introducing foreign substances between cartridges of explosives and other equally dangerous methods which not only eliminate the safety qualities of the explosives but enhance the chance of a resultant dust or gas explosion.

The American manufacturers deserve a great deal of credit for their efforts in producing suitable permissible explosives to meet the economic conditions in the coal mines of this country. Many of the permitted explosives used in European countries would not be suitable for use in the bituminous coal mines of this country for the reason that they are much stronger and quicker in action. If such explosives were used in mines of this country according to our American practice, depending in a great measure on the execution of the explosive, they would fail in their purpose. For this reason the American manufacturers have found it necessary to reduce the strength and quickness of explosives for coal mining purposes by adding inert materials or restraining substances. With explosives of this kind the average miner after a short time obtains successful and satisfactory results.

Ideal Explosive for Hard Coal.

The ideal permissible explosive for use in shooting hard coal would be one that has a comparatively high rate of detonation containing all combustible materials and which on detonation produces the maximum volume of gases. Explosives of this kind could, no doubt, be used satisfactorily under all coal mining conditions, but, as stated before, they would have to be used in small quantities, in an intelligent manner, in coal previously mined so that the amount of explosives required would be to simply exert a wedging effect on the coal.

This procedure is followed in many European countries and in some cases no explosives are used in friable coal or where the longwall system is used, but it is not expected that these conditions will obtain in this country for some time. Considering the comparatively high wages paid to miners in this country, cheaper coal can no doubt be produced with explosives rather than by pick work exclusively, but the excessive use of explosives, as practiced in many of our mines to-day, is certainly unnecessary and a menace to safety.

In order that the users of permissible explosives may know the nature and characteristics component of permissible explosives, I will take up the different kinds of explosives as classified in Miners' Circular 2.

Class 1. Ammonium nitrate explosives. All explosives belong to this class in which the characteristic material is ammonium nitrate. This class may be sub-divided into two classes.

a. Containing a sensitizer which is itself an explosive.

b. Containing a sensitizer which is not in itself an explosive.

All the ammonium nitrate explosives mentioned in the circular belong to sub-class "a" with the exception of Kanite A and Mazurite M. L. F. These two explosives contain sensitizers which are not in themselves explosives and, accordingly, are classified under sub-class "b."

The ammonium nitrate explosives of sub-class "a," consist principally of ammonium nitrate with small percentages of nitroglycerine, nitrocellulose, or nitro-substitution compounds which are used as sensitizers. The explosives Aetna coal powder AA, Bental coal powder No. 2, Bituminite Nos. 5 and 7, Coalite 3X, Coal Special No. 4, Collier powders Nos. 3, 5, 5 Special, 5 L. F. and X, and Monobel Nos. 1, 2, and 3 are explosives of this class and contain nitroglycerine as a sensitizer. They are similar in composition to or a slightly modified form of the English explosives Abboite and Monobel.

The explosives Hecla No. 2, Titanite 32, 7F, and 8P are explosives of the ammonium nitrate class under sub-class "a" and contain nitro-substitution compounds as a sensitizer. These explosives, as well as those which will be mentioned later, under sub-class "b," have the advantage of not freezing when exposed to low temperatures for the reason that nitroglycerine is not used as an ingredient. They are a modified form of the English permitted explosives Withnell and Faversham.

Ammonium Nitrate Explosives.

The ammonium nitrate explosives of sub-class "b," namely, Kanite A and Mazurite H. L. F., consist principally of ammonium nitrate with small percentages of metallic oxides or other non-explosive compounds used as sensitizers. They are a slightly modified form of the English permitted explosive Westfalite. They are detonated with difficulty, requiring an extra strong detonator and for this reason and the fac' that they burn with great difficulty, are one of the safest classes of explosives in respect to handling and transportation.

All of the ammonium nitrate explosives are quite deliquescent, absorbing moisture from the atmosphere very readily, and great care should be exercised in storing them or using them in damp places. They are not suitable for use in wet mines. If an original package of an ammonium nitrate explosive is opened in such mines and the cartridges are exposed for only a few hours to the damp atmosphere, they will deteriorate, and many failures to completely detonate are attributed to this cause. The ammonium nitrate explosives when stored under favorable conditions for only a few months, show signs of deterioration, and nearly all explosives of this class, after six months' storage at the Pittsburg testing station, have failed to detonate or detonated incompletely when retested. For this reason the ammonium nitrate explosives should be obtained in as fresh condition as possible and should be used as soon as possible after their receipt. The ammonium nitrate explosives when in a fresh condition have the advantage of producing on detonation small quantities of poisonous and inflammable gases and are especially recommended for mines that are not unusually wet and also in mines and working places that are not well ventilated.

Features of Other Classes.

Class 2. Hydrated explosives. All explosives belong to this class in which salts, containing water of crystallization, are the characteristic materials and which modify the results of the explosion. They are somewhat similar in composition to the ordinary low grade dynamites, except that one or more salts containing water of crystallization are added to reduce the flame temperature. They are not now in general use and tests at the station and in the field indicate that the four hydrated explosives on the list at the present time are not as efficient as some other types of explosives. They have the advantage of being easily detonated, producing small quantities of poisonous gases, and can be used successfully in wet holes.

Class 3. Organic nitrate explosives. All explosives belong to this class in which the characteristic material is an organic nitrate other than nitroglycerine. The permissible explosives of this class are listed in Miners' Circular 2 as nitro-starch explosives. They do not contain nitroglycerine and for this reason do not freeze. They contain large quantities of inert matter and, therefore, are not as effective as they might be if they were made containing smaller quantities of this material.

Class 4. Nitroglycerine explosives. All explosives belong to this class in which the characteristic material is nitroglycerine. Forty of the explosives on the permissible list are classified as nitroglycerine explosives. The flame temperatures of this class of explosives are reduced by addition of free water or by using an excess of carbon for the purpose of reducing the amount of carbon dioxide formed. A few contain salts which reduce the strength and shattering effect of the explosives on detonation. They are somewhat similar to or a modified form of the English permitted explosives Britonite, Carbonite and Kolax. The nitroglycerine class of explosives have the advantage of ease of detonation and not being readily affected by moisture. Less skill is required in their use and the average miner obtains satisfactory results with this class of explosives in a much shorter time than with the other explosives. They have the disadvantage of freezing at comparatively high temperatures and even when nitro-substitution compounds or other materials are added to lower the freezing point, they will not remain unfrozen when the temperature falls below 35 deg. Fahrenheit. They produce a large percentage of poisonous and inflammable gases on detonation, many of them producing qualities equal to that of black blasting powder, and for this reason should not be used in mines that do not have efficient ventilation.

Means of Detonation.

Permissible explosives are detonated by means of detonators or electric detonators, the weight of fulminating charge varying according to the type of explosives used. Detonators are usually employed in connection with fuse for firing charges of explosives. When detonators are fitted with a means of firing them with an electric current, the device is called an electric detonator. As electric detonators are embedded in the explosives with which they are used and isolated by means of stemming, they are the safest means of igniting charges of explosives in gaseous mines. Fuse has, therefore, been called safety fuse and the practice still obtains, though the word safety has come to mean something far different than the original intention when associated with the word fuse. The variation in the moisture conditions of material to be blasted has necessitated the manufacturers of fuse to make several kinds in order that they will be adapted to the various conditions. There are five classes of fuse, as follows:

1. Fuse for use in dry material.
2. Fuse for use in damp material.
3. Fuse for use in wet material.
4. Fuse for use in very wet material.
5. Fuse for use in submarine work.

The first two classes are generally used in the coal mines of this country. They are the cheapest grades and on account of the lateral sparking which obtains on burning, are not recommended for use with permissible explosives. If the detonator is buried in the explosive, the lateral sparking which occurs with these types of fuse, may set fire to the explosive about it before the detonator is set off. This has been the common cause of inferior and dangerous explosions.

Classes 3, 4, and 5 are well made fuse and these grades show little, if any, lateral sparking or glowing at the sides. However, even these classes of fuse are not considered permissible for use in gaseous mines. Tests made at the station with fuse generally offered for sale in this country, have shown that the end spitting of the fuse will cause ignition of inflammable gas mixtures.

A New, Safe Fuse.

A new kind of fuse has recently been substituted at the station and the tests so far made indicate that it will be much safer than the fuse now generally used in coal mines. This fuse is of a good mechanical construction, having a sufficient ratio between the pressure required to burst through the envelope of the fuse and the pressure produced within it by the burning powder train. The quantity of powder per foot is less than that which obtains in the ordinary fuse and in the preliminary tests which have been made at the station, no ignitions of inflammable gas mixtures have occurred from the spit of this fuse. However, as fuse does not per se contain its own means of ignition, it cannot be considered apart from the fuse igniter, a means employed to cause the ignition of the fuse.

Clearly, any fuse igniter that would ignite gas when properly attached to a fuse would be condemned as well as any fuse igniter which did not surely ignite fuse with which it is used. No great difficulty should be encountered when perfecting such a fuse igniter, for there has been submitted to the Pittsburg station for test, a fuse igniter which, though it failed to pass the requirements, has some merit. It should not be concluded, however, that any fuse having the proper envelope and even when a safe and reliable method is provided for its ignition can be safely used in a body of inflammable gas. There are various kinds of fuse sold of different rates of burning, varying from 18 seconds per foot to 40 seconds per foot when tested in the open air. The miner or shot firer seldom have the information of the rates of burning of the different kinds of fuse.

It is true that some fuse is marked slow or fast burning and it is also indicated by different colors of paper wrapper, but this is not always the case. Without such information a miner may become accustomed to a certain fuse and on using another brand of a faster rate of burning, the charge may explode prematurely. This is a menace to all connected with the work. It is generally conceded that the use of fuse of different rates of burning is not desirable, that if all classes were made to burn about 90 seconds per yard in the open air and this rate maintained within 10 per cent. over or under the stated time, such requirements would meet all ordinary mining conditions and offer greater assurance of safety. The manufacturers of fuse realize that the many kinds now manufactured having different rates of burning are unnecessary, and they would, no doubt, welcome a universal rate of burning of fuse. It is believed that the required rate of burning of fuse, namely, 90 seconds per yard, recently adopted by the Isthmian Canal Commission and the United States Reclamation Service, would meet the various mining conditions in this country.

The tests which have been made by the spit from squibs invariably ignite inflammable gas mixtures. As squibs must be propelled from the mouth of the drill hole to its heel by a propelling power of the spit of the squib proper, it seems quite impracticable to adequately protect this spit from inflammable gas mixtures within mines and hence the use of squibs of any kind cannot be recommended for use in mines generating inflammable gases.

The system of firing shots in connection with electric detonators from the surface when all men are out of the mine, previously adopted in Utah, has been introduced in Colorado, Alabama, and other states. This method has many advantages and its adoption in mines where the local conditions permit would, no doubt, reduce accidents in coal mines.

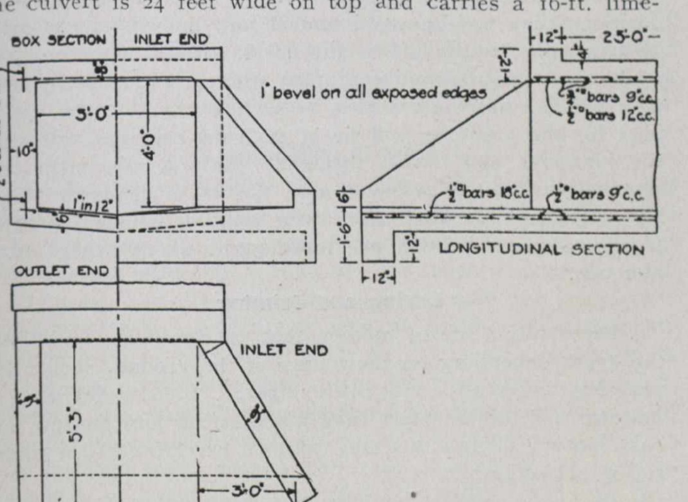
The dangerous practice of using inflammable material for stemming is generally being remedied by the employment of clay and like substances in all parts of the country. The humidifying of mine air by means of steam and water sprayers has progressed rapidly in the last two years. The enforcement of the law by the state mine inspectors concerning coal mining operations has greatly improved in recent years. The mining conditions of this country as regards preventives of explosions, are approaching a position of equality with European countries, and it is expected that there will be a steady reduction of accidents from this source in the coal mines of this country in the future.

DESIGN AND COST OF A CONCRETE BOX CULVERT.

In a recent issue of Good Roads the following article appeared on the design and cost of a concrete culvert. Mr. C. R. Thomas, Highway Engineer, U.S. Office of Public Roads, is the author.

The culvert illustrated is located two miles from the town of Ennis, Ellis county, Texas, on one of the roads being improved under the $230,000 bond issue recently voted in that locality.

It is of the box type, a design economical of material and suited to use in a soil that washes badly. The fill over the culvert is 24 feet wide on top and carries a 16-ft. lime-



Sketch of Reinforced Concrete Box Culvert Near Ennis, Tex.

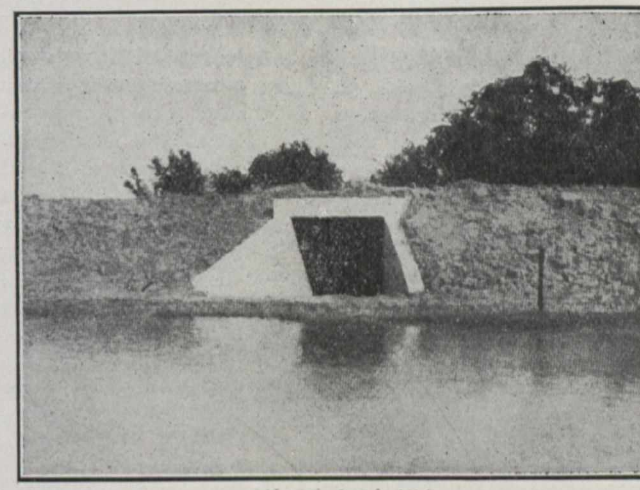
stone gravel road. The drainage from approximately 100 acres of hilly land flows through the culvert. The drainage area is round and rather abrupt.

The work was done by the regular county concrete gang, composed of a foreman, seven men and two teams with drivers, and was completed in 4 days of 10 hours each. The excavation was light, but the soil was of a hard, black nature that was hard trimming. Water for mixing had to be hauled two miles.

Sand gravel was used for aggregate in the concrete. The gravel contained a slight excess of sand and worked up in the proportions given. Mixing was done by hand with negro labor. Twisted square steel bars were used for reinforcing.

The specifications of the Illinois State Highway Commission were used throughout.

The quantities were as follows: 14½ cu. yds. of 1:3:5 concrete; 4 cu. yds. of 1:2½:4 concrete; 432 lbs. of ¾-in. steel; 640 lbs. of ½-in. steel; and 1,000 ft. B. M. of lumber.



Reinforced Concrete Box Culvert Near Ennis, Tex.—General View, Inlet End.

The work was done in July, 1911; and the costs were carefully kept, both for labor and materials. The two tables following give costs in detail, and also the costs per cu. yd. of concrete in place.

Labor.

Foreman, 40 hrs., @ 25c	$ 10.00	
Culvert excavation, 9 cu. yds., @ 80c	7.20	
Labor on forms	14.00	
Mixing and placing, 120 hrs., @ 15c	18.00	
Hauling water, 20 hrs., @ 30c	6.00	
Cutting and placing steel, 10 hrs., @ 15c	1.50	
Cleaning up and removing forms, 10 hrs., @ 15c	1.50	
	$ 58.20	
50% salvage on form labor	7.00	
	$ 51.20	
Moving on and off job	10.00	
Total labor at culvert		$61.20

Material (Laid Down at Culvert).

Cement, 26 bbls., @ $1.80	$ 46.80	
Hauling cement, 12½ hrs., @ 30c	3.75	
Gravel, 18½ cu. yds., @ $1.10 f.o.b. cars, Ennis, Tex.	20.35	
Hauling, 18½ cu. yds., 46 hrs., @ 30c. (75c. per cu. yd.)	13.80	
Steel, 1,072 lbs., @ 2½c	26.80	
Hauling steel, 2 hrs., @ 30c	.60	
Lumber, 1,000 ft. B.M., @ $25.00	25.00	
Hauling lumber, 3 hrs., @ 30c	.90	
	$138.00	
75% salvage on form lumber	18.75	
Total cost of material at job		$119.25
Total cost of job		$180.45
Cost per cu. yd. of concrete in place exclusive of culvert excavation	$ 9.37	
Cost per cu. yd. of concrete in place exclusive of excavation and steel	$ 7.85	

THE LAYING AND TESTING OF EARTHENWARE SEWERS AND DRAINS.*

By A. SAYERS, Lecturer in Sanitary Engineering, Municipal Technical Institute, Belfast.

The question of pipe laying and inspection being such a widely-discussed subject, it might almost seem needless to dwell further on the matter. Be this as it may, one cannot help feeling at times that more attention is often paid to the theory of the subject than to the matter of actual practice; and notwithstanding the progress that has been made, and the improvements that have attended the efforts put forth, to-day the average work to be met with still leaves much to be desired, not only as regards the quality and uniformity of the workmanship, but also as regards the nature and quality of the pipes employed. If this paper succeeds in drawing the attention of the members of the congress to the urgent need there is for the standardizing of pipe laying, and for inspection, it will have fulfilled its purpose.

The Pipe Layer.

It is not until one commences to study that interesting personality, the man who lays the pipe, that one realizes the force of the Biblical expression "You cannot gather grapes from thorns;" no more can you get good sewer work done by untrained workmen. Is it not surprising that, even at the present day, much of this class of work is done by casual labor? We are very careful, and rightly so, as to who will make our clothes or compound our medicines, and we will have none but the best workmen paint our houses; but how many ever give a thought to, or care about, the qualification of the workman who lays the sewer pipes. Does it not seem useless writing books or lecturing about drain laying and sewer construction if the doing of the actual work is left in the hands of every Tom, Dick or Harry who will undertake, and is allowed to undertake, the laying of sewer pipes?

Let me give you an instance of this. Not very long ago, when visiting a large engineering job in the North of England, where there were some miles of sewers being laid (which particular part of the work, by the way, was being anything but well done), in conversation with the resident engineer on the job I asked him who laid the pipes. "Any of those navvies," he remarked in an off-handed sort of way. I ventured to suggest that he was fortunate in having such a number of men capable of doing such important work, and I was told "They jolly well have to." On this important engineering work the sewer work was evidently being done by what could not be dignified by any better title than casual labor.

Nor is this an isolated case, as many others could be mentioned. In how many parts of the country do we find the drains of private houses laid by the ground laborer or hodsman who happens to be on the job! Again, in connection with the alterations and reconstruction of drainage, in many places the work is in the hands of handymen who are proverbial for patchwork. Nor is this unsatisfactory state of affairs confined to one or two areas, but is a practice common all over the country. While this state of affairs exists the highest standard in drainage work cannot of course be reached, for have not the efforts of the engineer and sanitary expert their consummation in the work of the man who lays the pipes. This being so, is it not of the first importance that the pipe layer should be an experienced and competent workman, possessed of not only practical skill, but also of such a measure of theoretical and technical knowledge as will enable him to interpret instructions and overcome the many difficulties that are to be encountered in every-day practice?

The author of this paper does not for a moment pretend that good drainage produces good health, but all are agreed that bad drainage may in some cases be the fountain-head of disease, and experience teaches that the foundations of many good buildings have been weakened by the leaking joints of badly-laid drains.

The time appears ripe for doing something to raise the standard of pipe laying, and establish, if possible, a uniform method; and what body is better fitted for such work than the institution under whose auspices we are met?

It is not proposed to argue what existing trade is best suited to take the matter up; but what I do say is that the pipe layer should be a properly-qualified and skilled workman of the first class, belonging to some particular recognized body of tradesmen, and that all others should be prohibited from laying new, or altering, or interfering with existing sewers or drains. An ignorant workman will open the trench at random, and try to make stock fittings fit into positions they were never intended for; he will try to turn corners with straight pipes, and do all sorts of other impracticable and unworkmanlike things; whereas the skilled workman will lay out the trenches in such a way that the openings for the branches will be at such an angle as will suit the junctions and stock fittings. He will also open the trenches sufficiently wide to give the workmen room when laying and jointing, and thus avoid walking on newly-jointed pipes—in short, he will use forethought which begets easy methods.

Laying and Jointing.

Personally I am of opinion that a concrete foundation, the depth depending on the nature of the ground, should be provided under all earthenware pipes. This would give a uniform bed for the pipes, and make laying and jointing an easy matter, though this may perhaps be considered a counsel of perfection.

Little need be said about jointing pipes if the site is dry, and the sewer not working while being laid; but if the trench is wet and water running through the pipes, the work of jointing is rendered more or less difficult. One may frequently see workmen trying to make ordinary cement joints on a plain spigot and faucet pipe in a waterlogged trench, even when the pipe is half full of water. Any workman who understands what he is doing would never attempt such a thing. Prohibitive measures of a local authority might with advantage be applied to put a stop to such a practice.

Most of the patent joints which are on the market lend themselves to jointing in wet sites, and many of them make reliable joints when laid by a competent workman; but, unfortunately, the price and other considerations are against

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*Abstract of paper read at the Royal Sanitary Institute Congress at Belfast.

the extensive use of patent-jointed pipes, and whereas this class of pipe is used by the yard, ordinary spigot pipes are laid by the mile, so that it is the latter class of pipe that claims most of our attention.

In a dry site the ordinary cement joint requires no further attention, but the size of the faucet, which may be taken as part of the joint, does require consideration. At present no two manufacturers of this class of goods make pipes of the same dimension; indeed, pipes from the same maker often show a considerable difference in size, and we find brought on to our works pipes with faucets of all shapes and sizes, from anything approaching the horn of a gramaphone to a tight glove fit that will not admit even the point of a jointing trowel, much less admit jointing material.

The "Tubous" Method of Jointing.

For the Belfast contractors engaged in the relaying of sewers which are in use, and also in new work in wet sites where satisfactory jointing by ordinary methods is impossible, the city surveyor has introduced what may be termed the "tubous" method of jointing. This consists of a canvas tube filled with cement, forming a sort of cement sausage, which is staved into the joint as a substitute for rope yarn, which is now universally condemned. This sausage, when carefully driven home, not only keeps the abutting ends of the pipes concentric at the joint, but prevents any cement finding its way into the inside of the sewer. It also of itself makes a watertight joint, as may be seen demonstrated. If there is much water lying in the trench, and the joint cannot be finished off in the ordinary way, a sheet-iron collar is bolted round the pipe, and the joint finished with cement grout, and after the cement has sufficiently set the iron collar is removd. The advantage of this type of joint is that it can be made on any pipe that permits of reasonable space in the faucet for jointing. It adapts itself to any circumstance, and by its use in the wettest trenches, even where the pipe is covered with water, a perfectly reliable joint can be made. Some of the local contractors prefer to employ this type of joint, even in dry trenches and in new work, finding that where the canvas tube is used a leaky joint is never met with, and that it is easier to bring the inverts of the pipes to a true alignment.

Inspection of Work.

The duty of laying out, supervising and testing the drainage work devolves upon the inspector or overseer, as the case may be; it is therefore essential that he, like the pipe layer, should be a man of experience, thoroughly competent to look after the work and deal with the contractors and workmen. Sometimes men of limited experience are called upon to discharge the duties of drainage inspector, to their own discomfiture and to the disadvantage of the work. Indeed, it is difficult to understand the policy of some local authorities in appointing officers to look after the execution of drainage work, officers who have little or no previous experience or training. One must sympathize with the man who thus has thrust upon him duties which he feels he has not the necessary experience to perform. Workmen as a rule are not slow to take advantage of want of experience or weakness on the part of the inspector, and it will be in the interest of all concerned if he has made himself thoroughly fit before issuing forth to take charge of work upon which may be the lives of those who employ him depend.

The inspector of experience recognizes in the first place that he is a public servant, and, as such, must be courteous and obliging with the public as well as the contractors with whom he comes in contact; he will be careful that his requirements are within the provision of the by-laws and regulations of the local authority he represents, asking for nothing extravagant or unreasonable, being always careful to lay out the work on economic and practical lines, as if the payment were to be out of his own pocket. He will never condemn work unless he is thoroughly satisfied it is wrong, and will never approve of work unless he is equally satisfied it is right. He must be always careful in giving a decision, and once the decision has been given he must adhere to it. It is a great mistake to condemn work to-day and approve of it to-morrow under pressure, persuasion or influence. The inspector who knows his business and has the courage of his convictions will not allow himself to be either intimidated or coaxed into allowing bad work to be passed.

The line and levels should be checked at each visit, no latitude being allowed for departing from fixed levels; strict inspection is conducive to careful pipe-laying, whereas inattention on the part of the inspector leads to laxity on the part of the workmen. Too often the inspector is satisfied to stand on the bank and give directions to those in the trench, and contents himself with a superficial inspection of the upper part of the pipe, and if the work looks all right on top leave the bottom to chance. Such a method is not by any means the best, for after all the top part of the pipe and joints are the least important. The inside of the pipe and bottom part of the joint being the more important, should therefore receive the greater attention. The inspector must not hesitate to get down beside his work, carefully examine each joint, see that it is concentric, and the faucet well filled and neatly finished off equally all round, and that no cement projects inside the pipe. This can best be ascertained by flashing a strong light, such as that of an acetylene lamp, through the pipes, and besides this will be found a ready means of sighting the line and gradient of the finished work, as a pipe ever so slightly out of line can be seen at once. When satisfied that the pipes have been laid in accordance with the fixed level in a workmanlike manner, the next step will be to test the system in sections. Whether this should be done before or after the trenches have been filled is a debatable point, but we all have had experiences of drain pipes being fractured by the workmen filling the trenches. This may have been due to accident or to carelessness. It is the business of the local authority to see that the work is perfect when everything is completed; that being so, it would seem that the proper time for testing is after all is finished. But testing before the covering up of the pipes would be a reasonable precaution on the part of the contractor to guard against possible flaws in the pipes or defective joints, for detecting a leakage or removing a fractured pipe afterwards is a very troublesome and expensive matter.

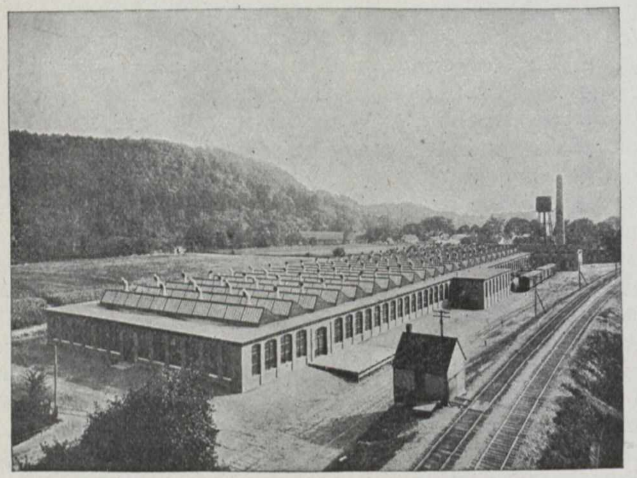
The Water Test.

It is to be feared that too much importance is sometimes attached to the water test. Many appear to think that if a system of piping is watertight, it is a guarantee that the work is perfect in every respect. Experience teaches differently, and it has happened that a very defective job was watertight—even a badly-made joint may withstand the water test or any other of the tests applied, and it is well to remember that there are other essential features necessary to make up good drainage work.

It must be recognized that the difficulties to be met with are many, but in the hands of qualified men with foresight and approved practical methods, all the little troubles can be overcome. There need be no excuse for bad drainage; nor is there any reason why, with proper care and supervision, the public should not be supplied with the genuine article for which they have to pay; for, apart altogether from the serious consequences which may result from defective drainage, the cost will ultimately exceed that of good work.

THE NEW SHOP OF THE WINDSOR MACHINE CO.

The Windsor Machine Co., of Windsor, Vt., have recently completed a new shop for the manufacture of automatic lathes. This building, which was designed by Lockwood, Greene & Co., of Boston, Mass., is characterized by the most modern features of this type of construction. The shop is one storey in height and measures 542 ft. 8 in. in length by 132 ft. 8 in wide. Beyond the end of the shop itself but contiguous to it is an extension 47 ft. 4 in. in length running the full width of the building, which contains the engine and boiler room and forge shop. Counting in this addition, the total over all length of the building is 590 feet.



Windsor Machine Company.

The outer walls are of brick and there are six 20-ft. transverse bays and one 10-ft. bay running the length of the shop in the center. Longitudinally, the columns, which are 9¾ in. square, yellow pine, are spaced 20 ft., there being 27 bays. The roof construction is of the sawtooth type, the sawtooth extending transversely with the glass frontage toward the north end of the building, as is the usual practice. The height in the clear to the bottom of the roof girders is 15 ft. 8 in. by 16 in., roof beams spaced 10 ft. apart carry the sawtooth. These are framed into 10 in. by 16 in. girders over the columns and at intermediate points. 6 in. x 6 in. x ½ in. x 14 in. angles are used to connect the roof beams with the girders, being held in place with lag screws. The sawtooth construction extends half way across each outside bay and the ends of each skylight are shingled. The girders are carried on cast iron caps on top of each column and are joined together over the column head by 36 in. x ¾ in. dog irons.

The shop floor has a 5-in. cement concrete base with a wearing surface of one inch granolithic floor finish of Portland cement mortar. The roofing consists of 5-ply tar and gravel roofing, laid on 3-in. yellow pine roof plank. The roof beams for the sawtooth sections are 6 in. x 8 in. size and are tied to the roof beam by means of ¾-in. vertical rods. An intermediate brace 6 in. by 8 in. is also carried down from the sawtooth roof beams to the horizontal girders below. In the engine and boiler room section of the building, which is divided from the main shop by the 16-in. brick wall, the roof is carried on riveted steel trusses which have a span of 40 ft. The engine room floor consists of 4-in. hard pine plank, over which is laid a one-inch maple top surface, while the basement floor consists of 4½-in. concrete. The basement floor level, which is 8 ft. below the engine room floor level, is approximately 5 ft. lower than the level of the shop. The boiler room is paved with hard burned brick set on edge.

Particular attention was paid in the design of this shop to obtaining the most efficient distribution of light and air. The use of the sawtooth roof and the fact that the building is but a single storey in height insures excellent distribution of light throughout the building. As an additional insurance that there should be no dark corners, all window sash are glazed with ribbed glass which acts as a diffuser, except the bottom sash, which is provided with double thick plain glass. Ventilators are provided on top of the sawtooth skylights, there being in all 140-24-in. revolving cowl ventilators.

A railroad spur runs lengthwise of the building on the west side, and a receiving platform at one end provides for the transfer of raw materials to the shop, while the corresponding shipping platforms at the other end of the shop takes care of the finished product. About midway of the length of the building on the west side is an addition approximately 82 ft. by 25 ft., in which are provided lockers and wash rooms for the employees. At the north end of the building are located the offices, the pattern shop and shipping room. In general, the entire remainder of the building is given up to the various processes involved in the manufacture of automatic lathes.

SALT FOR DUST LAYING.

As a general rule, says the American Consul at Havre, the roads in and around French towns are tarred at the commencement of the summer, in order to abate the dust nuisance. It has, however, been found that tar, although excellent in the case of macadamized roads, is of little or no value where tramway lines exist and paved street crossings intersect the roads in every direction, as tarring cannot be carried out on stones. The authorities, basing their action on the well-known hydro-metrical properties of common salt, have made a test of its value in laying the dust. Twenty yards of roadway have been sprinkled liberally with salt and then watered freely. If the results are satisfactory salt will be used throughout the town of Havre, it being impossible to tar the majority of the streets, as they are paved with rough stone blocks.

MAKING SEWAGE PAY.

The sewage of Berlin, Germany, amounts to 200,000 cubic meters daily and that city has turned it to advantage and profit. A sandy waste has been converted into a most beautiful and profitable agricultural area. Intensive farming has been carried on upon a small scale on this tract and small fortunes have already been made by tenants who have taken up sections of this well irrigated land. Twelve thousand cows secure pasture and provide the city's milk supply. There is a lake in which carp noted for their fine flavor, are raised. The sewage is subjected to a treatment which renders it odorless and innocuous. The meats, fruits and vegetables raised on the land are sufficient to supply the needs of all the city's hospitals and similar public institutions and thus, what elsewhere is considered commonly offensive, has been turned into a profit by Berlin.

The Canadian Engineer

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THE DEFEAT OF RECIPROCITY.

Thoughtful Canadians, no matter which country rocked their cradles, do not gloat over the defeat of the government. They rejoice at the overthrow of reciprocity. The pilgrimage to Washington early this year was made with the best intent and the most harmless of motives. The fact remained that it was the thin end of the wedge for the cleavage of British connection. In our present economic, financial and general strength, it could mean little else, when matching our wits and commercial sinews and muscle against those of an enterprising and astute neighbor.

President Taft thoroughly recognized the vital importance of the issue. He was more frank than any man in North America in giving utterance to its import. He plainly stated that Canada was at the parting of the ways. On Thursday, Canada gave her reply, turning to its own land, its flag, and the British Empire. It was partly a matter of sentiment, but the occasion was one of those few in the world's history when sentiment helps to write the future pages of the historical tome.

In the matter of business, the country recognized that Great Britain is still our best market, and that the United States still have the privilege of lowering their tariff barriers should they desire our products, minus duty. When Canada becomes a commercial giant, as the United States now is, then will be the time to have an international conference at Washington. Two nations, speaking the same language and trading as two nations on one continent as we do, may be an economic curiosity, but unusual governing circumstances have made it not only a possibility, but also a practical permanency, producing prosperity.

The news is now known in every part of Great Britain and its Dominions overseas. There is surely in the message an invitation to the Motherland to become more strenuous in its duty of knitting, commercially, and otherwise, the integral parts of the British Empire. We on our part have given this signal token of our loyalty, our independence, and our faith in the future and the Empire's cause.

POLLUTION OF STREAMS.

The pollution of streams by manufacturing waste is a subject about which a good deal has been written in the United States. We, to the present time, have not troubled greatly, as the problem did not come up here for solution. However, with the increase in manufacturing, particularly in our more thickly settled localities, this is becoming of great interest. There is a growing tendency on the part of the public to resist all pollution of streams. Mr. W. S. Johnson, a sanitary engineer of Boston, recently discussed this question before the congress of the Massachusetts Institute of Technology, and some of his remarks given hereafter apply with equal force to our own conditions. He said in part that in the case of streams the public is beginning to demand something more than protection to health. It requires that the stream shall become, as they will if kept clean, the most attractive features of the neighborhood. It is at the same time becoming better understood that it is possible to have clean streams, even in a region devoted to manufacturing, and that the expense of securing this condition is not such as to drive the manufacturer from the district. In fact, this movement for clean streams is so widespread that the manufacturer would have difficulty in finding a location where he would feel certain that this demand will not arise, either now or in the near future.

It is certain that this public demand, enforced as it has already been by the legislatures and the courts, and the demand of the manufacturers themselves, who require clean water in the manufacturing processes, will result in the necessity of keeping out of many of our streams the most objectionable of the manufacturing wastes, and this has become one of the serious problems to be met by the manufacturer.

The simplest solution of this problem, so far as the manufacturer is concerned, is to make, where possible, a connection with the public sewers, transferring the problem of the disposal of the wastes to the public authorities; but this method of disposal is, in many cases, impossible and its feasibility in other cases questionable.

In this country the tendency is rather to prevent the discharge of any considerable quantity of untreated manufacturing wastes into the sewers, and to oblige the manufacturer to construct independent works, or at least to treat the wastes so that they will not cause trouble in the sewers or at the disposal works.

The quantity of liquid wastes produced at a single factory is frequently greater than the total quantity of domestic sewage flowing in the sewers of the town in which the factory is located, and the character of the wastes may be such that they cannot be purified in connection with the sewage except at a very great increase in the cost. The cost of the sewers and of sewage disposal is largely assessed upon those benefiting by the sewers and in proportion to the benefits received. If a proper portion of the cost should be assessed on the manufacturers the assessment would be in many cases enormous, and enough to make such disposal practically prohibitive.

Some wastes can undoubtedly be discharged into the sewers without causing trouble, depending on the character of the wastes and their volume as compared with the volume of domestic sewage flowing in the sewers. Other wastes can be discharged into the sewers after some simple preliminary treatment without causing trouble; but in perhaps the majority of cases, where wastes cause trouble in the stream, they are likely to cause trouble in the sewerage system, especially if the sewage is purified.

Manufacturing wastes vary very greatly in their composition, and generally have quite different characteristics from domestic sewage. In some cases the wastes are very much more readily disposed of by dilution than is domestic sewage, while in other cases the effect of dilution is very much less. No fixed rule can be applied to the amount of manufacturing wastes of any given kind which can be discharged into a stream of given volume, for the seriousness of the pollution depends on the use to which the water is put even more in the case of manufacturing wastes than in the case of domestic sewage.

SCIENTIFIC MANAGEMENT.

At the Labor Congress just held in Calgary the system of Scientific Shop Management was up for discussion, and was condemned very emphatically by the Congress. The following resolution was carried unanimously:—

"Whereas a system of so-called scientific shop management, commonly known as the Taylor system, is being introduced in some of our large manufacturing centres; and whereas, the said system on investigation can be shown to be nothing more or less than a speeding-up process, where none but the very strong can survive, they being crowded constantly to the extreme point of physical endurance; and whereas, the said Taylor system is of such a character and nature as to be detrimental to the best interests of the Canadian working man; and whereas, the highest function of any Government should guard with zealous care the happiness and welfare of its great army of workers; and whereas, the partial or complete installation of the said Taylor system into any of our factories or workshops is a matter of grave importance to the people of Canada, and may be fraught with consequences of a far-reaching character both to capital and labor; and whereas, the declared purpose of the so-called inventor is to extend the system to all branches of industry; and whereas, any and all attempts of introducing the aforesaid system in Canada will surely lead to industrial disputes;

"Therefore, be it resolved that the Trades and Labor Congress of Canada instruct its Executive to assist any body of workers so involved to secure Government investigation and protection."

The members of the Labor Congress present at that meeting hardly understand the principles involved in the idea of scientific management or they certainly would not have expressed themselves in the above way. The so-called Taylor system, which is now coming into effect in very many of the American factories, and will, no doubt, be introduced into Canada when its many advantages become better known, should not be called a speeding-up process. The idea behind it is that a man should be paid a fair rate for what he does, and that a man should be paid according to his work in place of the semi-military system of schedule wages in use at the present time.

The system in its broadest outlines consists of standardizing work and its worth, instead of the old, useless attempts to standardize men and wages. When this system is adopted, as it will be adopted, it will be found here, as it has been found in the factories where it has already been tried, that the average wage of the men is increased, while the cost of production is decreased for the consequent increased shop output.

In a recent address upon the remarkable results of this advance in business methods and management, Mr. Harrington Emerson, an engineer who has had a large and varied experience as factory adjuster and expert, said:—

"Because the better men are rewarded for their greater skill and industry; because the check on every operation permits the correction of any condition which is detrimental to the worker; because it also permits, infallibly, the detection of incompetent, listless men, it is possible, month by month, to move the efficiency line forward."

We believe that the Labor Congress have a wrong idea of the principles of scientific management, and that it is not a case of speeding-up process, where none but the very strong survive, they being crowded constantly to the extreme point of physical endurance, but it is rather a system where each man does his best, and is paid for his best without a consequent reduction in his wage.

In this issue of The Engineer will be found a review of Mr. Taylor's book on the Principles of Shop Management, which will be of interest to all employers of labor.

EDITORIAL COMMENT.

The annual convention of the Ontario Chapter of Architects was held in Ottawa, September 13th to 15th, the meetings being held in Carnegie Library. The following officers were elected for the coming year: President, A. F. Wickson, of Toronto (re-elected); vice-presidents, Jules F. Wegman, of Toronto; C. P. Meredith, of Ottawa; treasurer, Grant Helliwell, of Toronto; and registrar, H. E. Moore, of Toronto. The selection of the next place of convention is left to the Council, which will meet in Toronto in a short time.

* * * *

In our issue of September 7th we noted Sir William Ramsay's remarks before the British Association on the necessity of the conservation of British resources, and his statements on this subject have rather overshadowed what he had to say on the English system of technical education. He takes issue with the system of making technical education a local, insisting that it is an Imperial question, and suggests a remedy of financing students by means of the insurance companies, the money being loaned to them during their years of study. What we are most interested in is his belief that technical education should be under the Central Government. We, in Canada, are beginning to appreciate this fact, and a preliminary step has been made in the Technical Commission recently appointed. There is no question, however, that this subject should be supported and largely financed by the Dominion Government.

* * * *

We have noticed recently in the "Surveyor," of London, frequent expressions of opinions on the inadequate salaries paid to British municipal engineers. Salary conditions there, it is evident, are gradually growing more unfortunate. From statements made of salaries received by local engineers and surveyors, we see that still more than in this country a comparison of the relative earning abilities of the engineer with that of the professional man results greatly to the disadvantage of the engineer. In a letter to the editor of the "Surveyor" we see very much the same state of affairs as exists in Canada. The writer states that the leaders of the profession are dormant on the matter of low salary, being satisfied from their point of view, and that it only needs some one to take the initiative, whereupon the question of superannuation, registration of engineers and unemployed men, owing to the present pupilage system, would soon be settled to everyone's advantage.

ROAD-BUILDING IN BRITISH COLUMBIA.

Considerable activity in road building in Fernie Riding, Kootenay, B.C., is indicated by a report from Frank C. Denison, Fernie.

The system in that district is under the direction of the Minister of Public Works of the Provincial Government. Until about two years ago there was no systematic road building carried on in the district. Such work as was done was in the construction of temporary roads where they were necessary, and much of the money appropriated for this purpose was, therefore, not used to the best advantage. Two years ago, however, the Provincial Government decided to carry on the work under a systematic plan, and in 1910 appropriated $65,000 for road construction in Fernie Riding. This amount was found inadequate, and the account was slightly overdrawn in order to complete the work laid out. For 1911 the appropriation amounts to $85,000, a part of which is to be used for the improvement of the existing roads.

The larger portion, however, will be devoted to the construction of a 75-mile east and west trunk road, from Wardner on the Kootenay river at the western boundary of the Riding to the boundary line of Alberta at Crow's Nest pass, at which point it will connect with the road system of Alberta. Improvements are being made on another through route which begins at the international boundary at Gateway on the east bank of the Kootenay and runs northerly to the intersection of the east and west road at Wardner.

In addition to the amounts mentioned, $15,000 has been appropriated for the extension of a wagon road from Corbin, the terminus of the Eastern British Columbia railway, near the summit of the main range of the Rocky mountains, southerly to the international boundary on the Flathead river where it connects with a highway from Beaton, Mont.

The east and west trunk line road is being built with a maximum grade of 8 per cent., which, according to Mr. Denison, will later be reduced to 5 per cent. This road is a link in the through road which is being constructed from the coast on the west to the Alberta line on the east. Another trunk line is being planned which will extend from some point on the Canadian Pacific railway east of the Rocky mountains to an intersection of the road already built up the Kootenay river and down the Columbia river. This is designed to form a loop line over the mountains and will be available for automobile traffic.

All the bridge work in the district is carried on with appropriations independent of those voted for road work, and it is reported that a considerable sum has been spent for this work. The most expensive bridge recently constructed in the Riding is one across the Elk river near its junction with the Kootenay, about 30 miles south of Fernie.

HARDWOODS.

Canada is dependent for its lumber supply on the soft woods of the forest much more than is the United States, as seen from the 1910 Forest Products report compiled by the Dominion Forestry Branch, and shortly to be published. Of the 1910 Canadian lumber cut, amounting to nearly five billion feet, only one-twentieth consisted of hardwoods or broad-leafed trees, worth barely five million dollars; on the other hand almost one-quarter of the lumber cut in the United States consists of hardwoods, which country had far greater hardwood forests than ever did Canada. Canada is already feeling a shortage of the hardwood supply and makes up the national deficiency by importing annually from the United States, hardwood lumber to the value of seven and a half million dollars. Thus the value of the hardwoods imported into Canada during 1910 exceeded by 50 per cent. the value of the hardwoods manufactured into lumber. Nearly all of these imports are from the United States and consist of the most valuable species such as oak, hickory, tulip or yellow poplar, chestnut, gum, walnut, cherry and a large amount of hard pine which is so frequently used as a hardwood. From these above figures it is seen that we are becoming more and more dependent upon the United States, whose available supply for export is surely and rapidly decreasing. Whatever can be done to improve the resources of Canada by the elimination of wood waste, and particularly by the development of the small wood lots of Ontario, Southern Quebec and the Maritime Provinces, should be done with all possible speed.

SOME MODERN FEATURES IN CONNECTION WITH SEWAGE DISPOSAL.

Read before the Sixth Annual Convention of the Union of Saskatchewan Municipalities, by T. AIRD MURRAY, M. Can. Soc. C.E.

In some quarters an impression prevails that many of the generally acknowledged or accepted standard principals appertaining to sewage disposal are becoming out of date. This impression is not without foundation, but just how far it is true is a subject of practical interest to sanitarians.

Last year the Provincial Board of Health of Alberta issued a circular to municipalities stating in brief that the whole question of sewage disposal was passing through a transmission stage; therefore, they generally advised caution. Such a statement is calculated to make those responsible for municipal expenditure pause and wonder just where they are at.

The necessity of efficient sewage disposal is generally acknowledged. It has been acknowledged for years in Great Britain, European countries and in the United States of America. Millions of dollars have been expended in schemes, in experimental work and in collecting data. Books and treatises innumerable have been produced dealing with the subject, both from the practical and scientific standpoints. A British Royal Commission recently closed a session extending over several years, held 144 meetings, examined 197 expert witnesses, and sent out circular letters all over the world asking for and receiving all kinds of data. This commission published their report which, in 1908, was considered the most complete and authoritative treatise on the subject of sewage disposal. The German government have been examining into the question and have employed not only expert engineers but expert chemists and biologists; they have issued from time to time reports and treatises which have been translated and have become common knowledge to the sanitarian. Many of the American States, such as Massachusetts, Ohio, etc., have formed central experimental stations, governed by experts, and have issued annual reports for years, handing out the most valuable and exact data and conclusions to the world generally. Many civil engineers and chemists have given their whole time and energy to this question of sewage disposal.

Now it is generally acknowledged that all these authorities are in agreement on certain general principals.

The generally accepted principals may be defined as follows:

(a) Sewage contains quantities of mineral and organic matter. The organic matter is found both in the form of suspended solids and solids in solution, and is liable to putrefaction. The process of putrefaction causes foul odors and is apt to create a nuisance at the point of discharge.

(b) Sewage contains the germs or bacteria of certain diseases, especially the infection of typhoid fever. These germs are found mostly in connection with solid matters, particles of animal tissue, etc.

(c) The putrefaction of the organic matter will not cause any specific disease. The organic matter, apart from the disease germs it contains, is harmless, and the gases which are given off, causing foul odors, are likewise harmless, as long as they are not in sufficient quantity to displace the natural oxygen of the air and thus cause asphyxiation. The germs of disease are not carried by the gases, and can only be liberated from the sewage by esplashing in the immediate neighborhood of the disturbance. Sewer air (at one time thought otherwise) is not capable of spreading contagion. Contagion or infection is only obtained by direct contact of some particle of sewage, containing the disease germ with food (solid or liquid). If sewage contained no disease germs (no matter how foul the sewage or otherwise) it could not produce typhoid or any other disease, even if it came into contact with milk or drinking water. The whole danger to health, the pathogenic danger, or the sanitary danger connected with the distribution of sewage is entirely due to the specific disease germs which have originally come into contact with the sewage. Sewage, in its purely chemical constituents, is not dangerous. Sewage, in its biological or bacteriological constituents, is dangerous.

(d) The ultimate aim in sewage disposal may consist of (1st) only dealing with the organic matter in such a way that it will cause no nuisance, viz., that at the point of discharge no putrefaction shall take place, and thus no foul odors will be emitted. (2nd) Dealing with the organic matter in such a way that all disease germs are exterminated, so that the power of distributing disease is taken away from the sewage. (3rd) Dealing with the organic matter in such a way that both of the above objects are realized.

(e) It is known that when the organic matter in sewage comes into contact with a liberal supply of oxygen, that the organic matter undergoes a change which renders it non-putrefactive and no foul odors are emitted. In order to avoid any foul odors or nuisance from sewage all that is required is that it be partly oxidized.

(f) The sewage disposal systems which have aimed solely at the avoidance of a nuisance by systems of oxidation have not been sufficiently complete to destroy the germs of disease.

(g) In order to exterminate disease germs from sewage it is necessary to go a step further than merely to provide a non-putrefactive sewage, and to provide some efficient system of disinfection.

There is not one of the above general principals which can be picked out and allowed to be in contradiction to the conclusions of all the great authorities upon this subject. These conclusions are not new, they have been understood and acknowledged by scientific men for many years now. Wherein, then, is there any foundation for saying that "old principals must give way to new"?

The fact of the matter is, it is not a question of principal but a question of application of acknowledged principals.

In Great Britain the general aim of sewage disposal has been and is to obtain a non-putrefactive effluent. The aim has been to remove sewage pollution from streams to the extent only of removing a nuisance. Average strength sewage contains approximately 3,000 lbs. of dried solid matter per each 1,000,000 gals. of sewage, 200 lbs. of which may be mineral and 100 lbs. organic. It has been found that in connection with rivers whose areas are thickly populated, that they cannot digest all this matter, and that they become foul in appearance and odor. In Great Britain, with one or two exceptions, the cities and towns do not obtain their domestic water supply from rivers flowing through inhabited areas. The water supply is generally from upland collecting areas or natural lakes, where there is no chance whatever of sewage pollution. Hence, efforts in sewage disposal in Great Britain have almost solely been directed to preserve the natural beauty and aesthetic appearance of streams, and not to make them fit as sources of water supply.

The city of London is an exception, as it takes its water supply from the upper Thames and its tributaries, which erceive sewage only partially treated. The London water supply undergoes most thorough purification treatment before distribution.

A great many of the cities of the United States take their water supply from rivers receiving sewage. It is customary in the States to purify all such water supply and insist only on partial treatment of sewage.

The question of disinfecting sewage—that is, of exterminating disease germs—is from the view of application comparatively speaking new. It has never been pretended by those who knew, that the generally recognized methods of sewage disposal, produced drinking water. Fakers there have been who have set up such pretensions, but such have been connected solely with commercial ventures. Germany was the first country to apply the principals of sewage disinfection, and the States of America have given more attention to this part of the subject than Great Britain or any other country, apart from Germany.

In 1909 E. B. Phelps, of the Massachusetts Institute of Technology published a report of extensive investigations and experiments in connection with the disinfection of sewage. These investigations and results have brought the whole subject of the disinfection of sewage effluents acutely before sanitarians.

Phelps showed that sewage is amenable to high degrees of disinfection by the use, as a mixture, of very small proportionate amounts of chlorine derived from chloride of lime. He showed that 3 parts per million of chlorine will satisfactorily disinfect the effluents from ordinary sewage works constructed for the removal of putrescibility, the bacteria being removed by 98 to 99 per cent., the cost being from $1 to $1.50 per million gallons of sewage. He also showed that, from 5 to 10 parts per million of chlorine will disinfect screened or settled sewage (that is, sewage from which part of the solids have been removed), at a cost of from $1.50 to $3.50 per million gallons. Phelps showed that absolute sterilization was not necessary, and that partial sterilization or disinfection was sufficient to kill off the disease germs.

These practical investigations and conclusions were interpreted by some as likely to revolutionize sewage disposal processes. They form the only possible foundation for the somewhat vague supposition that "Sewage Disposal Methods are undergoing a transmission stage".

Such investigations have, however, had no appreciable effect upon the standard methods of sewage disposal.

The preservation of the natural condition and appearance of a stream and the avoidance of all nuisance from odors is just as an acute question as ever. Disinfection of sewage will not remove or diminish the 3,000 lbs. of solids per 1,000,000 gallons of sewage entering a stream. Disinfection may retard putrefaction for a time, but only for a time. Disinfection will not satisfy the person who sees actual filth floating in a stream, no matter how sure he may be that all the germs of typhoid or otherwise have been eliminated. On the other hand disinfection or elimination of disease germs added to the standard processes for the avoidance of actual nuisance may in many cases prove valuable and prove not a revolution of standard processes, but simply a development.

Disinfection of sewage effluents is likely to prove the most prominent and useful of modern features. It must be acknowledged that no sewage effluent, if only treated up to the stage of removal of putrescibility, has any right to enter a domestic water supply source. In the case of sources which are not available for water supply such may continue to receive either partially treated or even untreated sewage.

What are the western conditions? and especially what are the special conditions relative to Saskatchewan?

In this province we have two large rivers, the north and south branches of the Saskatchewan River, which have their source in the Rocky mountains. Other streams are small in capacity, mostly running dry in the summer season. This province, unlike Great Britain, presents no features which will allow of collected upland waters. The annual rain-fall is small, the ground porous, the country flat, and evaporation great. Apart from shallow surface wells, and the small creeks or streams, the two main factors of pure water supply are the two branches of the Saskatchewan river and the tributaries connected with them. It is absolutely essential, apart from aesthetic value, apart from the question of nuisance, and apart from any other question, that every effort be made to keep out of our rivers, streams, creeks and other visible sources of water supply all causes of disease infection.

What would you think if it was proposed to any municipality which you represent, that you spend several thousand dollars in avoiding an apparent nuisance to the senses and you were told at the same time that such an expenditure in no way affected the chance or otherwise of spreading typhoid?

Large cities with an abundance of capital available may be warranted in ignoring the question of perfect sewage disposal, because they can afford the expensive luxury of perfect water purification. But they are only warranted as far as the matter effects them locally. The small community, and the individual farmer cannot afford expensive methods of water purification. A city may obtain its water supply from a polluted river and filter and so treat that water as to render it pure. The city may receive its milk supply from farmers located on that river where the filtered city water is not available, and where the farmer may have to depend upon unfiltered water for domestic purposes, washing of milk cans, etc.

Western Canada can, at the present time, boast of practically pure stream waters, from the sewage contamination point of view. The amount of sewage discharge is yet small; it will, however, be an increasing amount. It is for the western people to determine that they will unite in so treating all sewage effluents that the greatest available quantity of water possible shall be preserved pure for domestic supply. It is in this connection that disinfection of sewage effluents is of more importance to Saskatchewan and the west than it is in Great Britain or in many parts of the United States, where the condition of the rivers has become practically hopeless.

The least costly and most efficient method of disinfecting sewage effluents is by the addition of small proportions of chlorine.

Chlorine cannot be economically or efficiently administered to sewage unless a large proportion of the solids are previously removed and the liquid sewage rendered non-putrefactive.

The admixture of chlorine does not revolutionize the standard methods of sewage purification. Where the standard methods were necessary in the past they are still necessary. Chlorine, used as a disinfectant, simply forms a continuation of the standard methods and forms a useful and practical adjunct to any sewage disposal system discharging an effluent into any body of water which, during its course, may be or is available as a water supply, either to individuals or to communities of individuals.

In Saskatchewan at present the government are insisting upon the purification of sewage to the extent of the elimination of disease germs where such effluents enter any body or channel of water which may be or is used for domestic water supply. Regina, Moose Jaw, Saskatoon, Prince

Albert and many of the smaller towns are at present engaged in installing up-to-date systems of sewage disposal which are in accordance with the standard methods, but which have, in addition, the plant necessary for thorough disinfection.

Modern features of sewage disposal may be summed up as follows:

(a) The removal of a large proportion of the solid matter by screening and sedimentation in tanks.

(b) The removal of the tendency to putrefaction by bringing the liquid sewage into contact with oxygen, generally by use of aerated filters, or when occasion will allow it, by dilution with large quantities of water containing the necessary dissolved oxygen required to oxidize the organic matter in the sewage.

(c) The removal of the tendency of the sewage to spread certain diseases if it comes in contact with food supply, or in other words the disinfection of sewage by the elimination of disease germs.

Apart from the discharge of sewage into tidal basins, it is generally necessary that the processes under (a) be followed. With efficient screening and attention much of the matter connected with nuisance production can be retained, and with the further application of sedimentation practically all the solids apart from very fine particles can be retained. Such an effluent, after screening and sedimentation, is amenable to disinfection by use of about 7 parts in 1,000,000 of chlorine. The question of leaving out the process of oxidation by means of aerated filters and relying upon oxidation by the body of water receiving the effluent depends as follows:

(a) Upon local conditions—such as, the extent, freshness, flow or circulation of the body of water, and whether used as water supply or otherwise.

(b) Or if disinfection be necessary, a careful study of the capitalized annual cost of the extra chlorine treatment required as against the capital cost necessary to install aerated filters requiring less chlorine.

In connection with inland streams and bodies of water which are required as sources of domestic water supply, it will generally be found that the whole three processes are necessary, both from point of view of efficiency and ultimate economy. No cut and dried method of sewage disposal can, however, be laid down which will fit in with all conditions. Within certain limits the whole subject, like most other subjects, is subject to common sense and the results of experience.

CORROSION OF RAILS IN TUNNELS.

The corrosion of steel rails in different localities of a railway is an interesting and important subject, bearing directly as it does on road expenses. Some particulars given in the Engineering Record of the wasting of steel rails in the tunnel at Land Patch, Pa., on the Baltimore and Ohio Railroad, U.S.A., which it 4,775 yards long, and which is operated with double-track traffic on a single-track line, show that the dampness and tunnel gases greatly reduce the life of the rails. Plain Bessemer rails have a life of about eighteen months, and the deterioration proceeds in the flaking of the scale from the rail until the edges of the base become quite sharp, and the rail has to be removed. At the last renewal chrome-alloy rails were substituted for Bessemer rails, and have now been in service for nearly three years. Not only have these chrome-alloy rails been found to resist corrosion much better than the Bessemer rails, but they also show fewer breakages, the number being less than one-fourth of those in the plain rails.

SUCTION-GAS ENGINES.

A paper on "Suction-Gas Engines and Producers" was contributed by Mr. W. A. Tookey to the Engineering Section of the British Association for the Advancement of Science at their annual meeting, in which he remarked that although during the last ten years or so a very large number of suction-gas plants had been installed in all quarters of the globe, it was difficult to obtain figures recording the actual performances with regard to fuel consumption, cost of maintenance, and cost of repair. Yet it was necessary that such records should be available so that comparisons might be made with competing types of motive-power generators, and more particularly with those which, according to test figures, would appear to compete very keenly with, if not, indeed, to surpass, gas power-plants in trustworthy and economical working.

The author had collected from his own tests and those available from various sources representative performances of suction-gas plants of various sizes when under test, not only when the power could be determined by means of some form of brake dynamometer, but when generating electric current—so taking into account the efficiency of the combined gas-electric set—and also when raising water under different "heads," indicating the comparison between fuel consumed and foot-pounds of work performed in such circumstances.

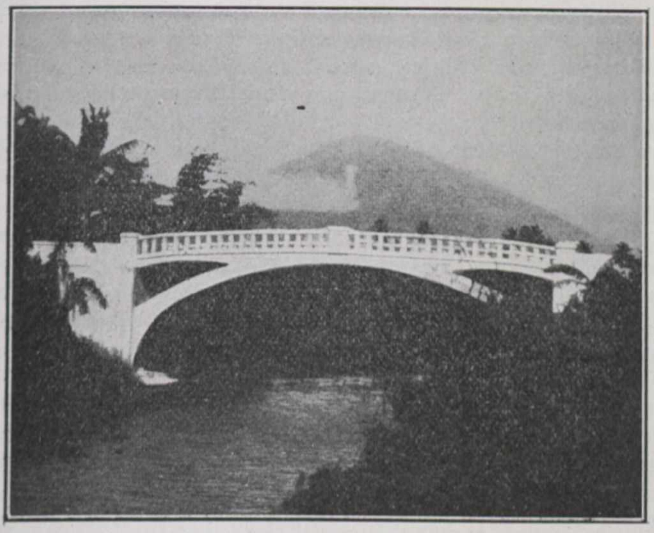
However, inasmuch as "test" figures were usually obtained under what must be admitted to be abnormal conditions—no account being taken of standby losses, wastage of coal in charging, in removal of ashes, &c., the engine and producer being worked at a constant and regular output for but a limited number of hours—further figures were presented which enabled the average performances of suction-gas plants of moderate power to be noted. These figures had been compiled from the statements of factory owners in Great Britain and in European countries. They took into account the variations of consumption due to the different grades of fuel used; they reflected the influence of variations of output, of load fluctuation, of length of standby periods, as well as the effect of the variation in the human element in maintaining or otherwise those conditions which made for the best gas-making and lowest consumption of fuel per unit of power delivered. Figures representing the consumption of lubricating oil were also given, as being of special interest in view of the criticisms that had sometimes been made in this respect. The experiences of users with regard to the cost of maintenance and repairs were referred to, and the question of capital outlay was considered for engines and producers.

The comparative costs of operation of liquid-fuel engines of the Diesel type were discussed. Although such engines were more efficient as regards utilization of heat units available in the fuel for conversion to power, yet they required several conditions to be fulfilled before the higher economy became apparent in the pocket of the manufacturer. Similarly, some points were suggested with regard to the relative performances of steam engines of the high-pressure, superheated, compound, condensing, semi-stationary type, in order to direct attention to the fact that although according to test results it would appear that suction-gas plants were threatened by a competitor which offered equal economy of operation, there were claims of a negative kind which must incline the balance of advantages in favor of the gas power-plant, at all events for moderate powers.

CONCRETE BRIDGE IN PHILIPPINES.

A concrete arch recently built in the Philippine Islands is described by Jay A. Rossiler in a recent issue of The Contractor. The following is extracted from the article:

Cement comes from China to Manila and is trans-shipped for the provinces. Reinforcing steel comes from the States. It often takes over a month for an order to be filled. Stone is a local product and is either used as gravel or broken by hand, often is volcanic, black and porous. A greater factor of safety is used in this case. Sand is obtained locally and is usually a volcanic product, black and of good quality.



Completed Concrete Highway Bridge.

Some of the methods of construction can be shown by a description of a special project which, through a miscarriage of usual methods, was designed and constructed by the writer, the Guinobatan bridge in Albay province, southern Luzon.

The original bridge at this point was a three-span rubble masonry arch bridge, built by the Spaniards, which was destroyed either by the elements or during the insurrection. It might be well to note that the Spanish structures seldom have sufficient foundation and many of their bridges have been saved by undermining the foundations and placing new concrete under them. In this case the old masonry was in the river. The military forces built a wooden Howe truss on cut stone abutments fifteen feet high. This truss was practically worn out and rotted and had to be supported by two auxiliary bents in its 60-foot span. It was desired to replace this with a 60-foot arch of concrete, using the abutments as end retaining walls.

Data were obtained as per standard questions as far as it was possible, but as some of the information, such as cost of piles, etc., could not be obtained, a design was not forthcoming after six months. The old bridge being in such bad condition that a pony stepped through the floor, it was decided that as the money was waiting, it would be wise to start work at once on our own design. The district engineer issued orders to start at once, which the writer did with 250 men.

New foundations had to be placed under the old abutments as they were not built as arch foundations. This was done by building a sand bag cofferdam around the work and digging out in sections and filling in with concrete, which was completed without difficulty.

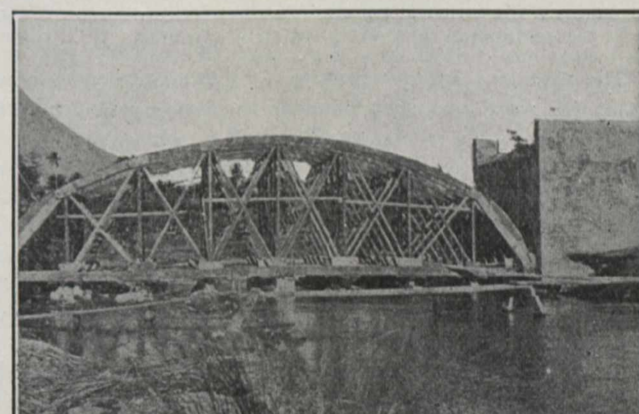
After spending time trying to clear the river of the rock from the old bridge, it was decided to build the foundation for the false work on the rocks. The river was about four feet deep over the rocks at this time, and the rock was in such a jumble that no wood could be made to stay on it. A large number of gunny sacks were obtained and filled half full of sand and these were then placed on the mass of rocks for a foundation. They were piled to the top of the water under each panel point of the false work. By experimenting it was found that these sacks would last about 50 days under water without rotting, so speed was imperative; 12-inch square timbers from the old bridge were laid on the sacks and the forms wedged up on them.

Using native carpenters, a rib of the proper shape was laid out and framed and the carpenters, none of whom had done this kind of work before, were then instructed to make six more exactly like the sample. Being good imitators, this was the easiest way to get it done. At the end of seven days the ribs were in place, bolted and wedged ready for the lagging.

There were seven ribs on 22-foot width of bridge and 2 inches by 12 inches lagging was used. Lagging was allowed to project 2 feet on each side by staggering them, and the projecting ends were used for bracing the side forms.

Several sheets of corrugated iron roofing were obtained, having been used on the cofferdam of one abutment, and a frame was nailed to them by using 2x4-inch flats. A concrete grout was poured into this frame and when nearly set, was cut up into blocks so that each corrugation left its mark on a block. These blocks, when set, were used to support the intradosal reinforcing, the rods being laid in the corrugations. It was not necessary to remove these blocks as they became a part of the final mass.

Stone was obtained by making an open agreement to pay fifty cents per cubic meter to anybody who would deliver it to a convenient place near the mixing boards. Natives



Arch Forms Used in Bridge Construction.

would rather work this way than by the day, as they can work when they feel like it. Many of them did this work by night and slept in the day. The requirement was that it must be clean river gravel of size as per sample, which was placed in a basket near the work. Any larger or smaller gravel was rejected.

Concrete was poured from mixing boards at each end of the bridge and wheeled to the centre. Fifty-six hours continuous work completed the main arch. The supplementary arches, designed as flat slabs, but having curved lower line to conform to the appearance of the arch, were poured three days later.

A strike was called the day before concrete was poured, to force salary payments to be made on Saturday night so that the money could be used in betting in the cockpit on Sunday. This Saturday happened to be the 15th of the month. The 17th was regular pay day. Although pay rolls were made out and the cash was in the safe at the office, it would not be policy to give in to their demands. Out of 250 men only 29 went to work. About 4 p.m. these 29 were paid and the others, although expecting their money too, were compelled to wait for the regular time. In order to be sure of enough men to complete the job, the presidente of the town was told that, unless he saw to it that the men were there for work on Monday a.m. we would get men of another tribe to do the work and the town would lose both the personal taxes and the wages of their own men. That settled our labor troubles for all times in that town.

The bridge was opened for traffic forty-two working days after the first gang started work, and the total cost was about $3,000. Cement hauled fifteen miles up country on bull carts, after a trip from China to Manila and Manila to Lagaspi, the port town, costs $3.33 per barrel. Oregon pine for forms cost about $36 per thousand, but as it could be used over several times on other work, it was not charged entirely to this job.

MODERN WATERWORKS PUMPING ENGINES: THEIR COST AND EFFICIENCY.

Four distinct types of engines (all condensing) have been developed to suit the various conditions imposed. Their costs, including foundations, piping and appurtenances, per million gallons per 24 hours' capacity, under average conditions, are as follows:

1.—Compound low-duty horizontal engines	$23.00
2.—Triple expansion low-duty horizontal engines	28.00
3.—Cross-compound horizontal engines	33.00
4.—Triple expansion high-duty vertical engines	48.00

The first two are non-rotative or "direct-acting" machines; the third and fourth are of the crank and flywheel type.

The cost of boilers with mechanical stokers, feed pumps, etc., ready for service will be covered by $20 per boiler h.p., based on the following average operating conditions: Water load against plungers, including suction and friction, 90 lb. per sq. in (= 207 ft. head); evaporation, 8 lb. per lb. coal, with feed at 150 deg. F., coal costing $3 per 2,000-lb. ton; steam pressure (gauge) at throttle valves of engines: 75 lb. for type 1, 125 lb. for types 2 and 3, and 150 lb. for type 4; boiler pressures 5 lb. higher.

Under present circumstances of unit capacity, cost of construction, economy of operation, space required, etc., water-tube boilers fitted with automatic stokers and damper regulators take the lead as steam generators for waterworks pumping engines. The practical relation between the economic duty of a pumping engine and the amount of boiler capacity required, is shown in Table I., which is based on the fact that in good ordinary practice 1 sq. ft. of heating surface will evaporate 3 lb. of water per hour from a feed temperature of 150 deg. F. into steam at 130 lb. gauge pressure; 10 sq. ft. of heating surface evaporating 30 lb. of water per hour, which is taken as 1 boiler h.p.

Table I.—Boiler H.P. Required for Each Pump H.P., Counting 10 Sq. Ft. of Heating Surface Per Boiler H.P.

Duty in ft.-lb. per 1,000 lb. of dry steam.	Boiler H.P. per pump H.P.
40,000,000	1.63
50,000,000	1.32
60,000,000	1.10
70,000,000	0.94
80,000,000	0.83
100,000,000	0.66
120,000,000	0.55
140,000,000	0.47
160,000,000	0.41
180,000,000	0.37
200,000,000	0.33

With boilers properly constructed and arranged, the values in this table will answer all reasonable purposes. If, however, caution of some special reason should suggest an increase in heating surface, any desired percentage of increase may be readily added without disturbing the relations of the different rates of economy. For example, if an evaporation of 2 lb. per sq. ft. be taken as the limit, the values in Table I. should be multiplied by 1½.

The limits of steam economy in the pumping engine are about reached, both theoretically and practically. The highest duty record was attained in 1906, being 181,068,605 ft.-lb. per 1,000 lb. of dry saturated steam. The leading type is a vertical triple-expansion condensing engine, with outside-packed plungers, mostly of the crank and flywheel type.

Table II. gives unit costs of pumping stations which are closely approximated and largely based on records. The figures given are for the best types of modern triple-expansion engines and high-pressure boilers; well-designed buildings of brick or stone (where the latter is cheap) with steel-trussed and slate-covered roofs; adequate chimneys; and intakes properly proportioned and thoroughly screened. The figures in the table, which include the cost of everything except the land, are so closely calculated, that an engineer or contractor should hardly guarantee the production of results without investigating each case independently.

Table II.—Cost of Complete Pumping Stations.

Pressure of water load pumped against, lb. per sq. in.	Cost of plant per million gallons capacity, including reserve.
30	$ 6,750
40	7,000
60	7,500
80	8,000
100	8,500
120	9,000
130	10,000

If there was no necessity for the use of steam jackets the duty per 1,000 lb. steam would approach 200,000,000 ft.-lb., and if superheating can save jacket steam and vitalize the working steam in the cylinders, this figure may be reached in the near future, in official tests, at least. Otherwise the upper limit has about been reached.

There are only two important items which grow less by higher duty—the coal account and the fixed charges on the boiler plant. Everything else increases except the wage account for equal capacities; with large high-duty triple engines this is somewhat less in the fire-room, because less coal needs to be handled in proportion to the pumping. The items in favor of high duty are maintenance, interest and sinking fund on boilers, and the coal account. Those against high duty are maintenance, interest and sinking fund on machinery, and the cost of oil, waste, packing, etc.

The fixed charges are as follows:

	Pumping engines, Vert. triple expansion.	All other type.	Boilers.
Maintenance	2%	3%	5%
Interest	4%	4%	4%
Sinking fund	3%	5%	5%
Oil, waste, packing, etc.	1%	1%	...
Total fixed charges	10%	13%	14%

Of all the types the vertical triple-expansion engine is probably the only one that will not be replaced as obsolete. Hence its life is assumed as 33⅓ years, and that of the others 20 years, making the sinking fund percentages 3 and 5, respectively.

With its limitation the centrifugal pump is an ideal machine for lifting water. At constant speed, however, for a considerable range of capacity, as is often found in water works, or for a varying head where domestic and fire service are combined in the same apparatus, it is inefficient and unreliable. Even on standpipe work, as at Schenectady, N.Y., it has been unsuccessful. The following figures of the comparative cost of pumping by displacement and centrifugal pumps are taken from a recent annual report of a water works:

Pumpage per day, U. S. gal.	9,000,000
Head against displacement pumps, ft.	207
Head against centrifugal pumps, ft.	23
Cost of displacement pumps	$50,000.00
Cost of centrifugal pumps	$10,000.00
Cost of fuel for both plants, per net ton	$1.25
Cost of fuel to pump 1,000,000 gal. 207 ft high:	
With centrifugal pumps	$6.48
With displacement pumps	3.27
Difference in favor of displacement pumps	$3.21

For pumping 9,000,000 gal. daily for a year the difference in fuel costs in favor of the displacement pump is $10,544. The mechanical efficiency of the displacement machinery was 93 per cent., and that of the centrifugal machinery 65 per cent.—corresponding with results attained in general practice.

It is quite probable that an increase in fuel economy of from 6 to 12 per cent. can be obtained by the use of superheated steam in the best types of modern pumping engines. A pumping engine at the Boston high-service station at Chestnut Hill Reservoir has a capacity of 30,000,000 U. S. gal. per 24 hours and its duty record is 178,497,000 ft.-lb. per 1,000 lb. of dry saturated steam. If the duty of this engine should be increased 12 per cent. by using superheated steam, it would then be 199,916,640 ft.-lb., which is about 2,000,000 ft.-lb. above the highest record with the use of superheated steam. The highest known dry saturated steam duty is—in round numbers—181,000,000 ft.-lb., and this would go up to 202,720,000 ft.-lb. with 12 per cent. increase, or considerably above the superheat results thus far obtained.

The tendency in public pumping engine development seems to be toward larger units, and the introduction of the high-duty idea into smaller and smaller units. The present day high-efficiency pumping plant involves the following items:

Vertical triple-expansion pumping engines of the crank and flywheel type;

Long stroke, with rotative speed not to exceed 20 r.p.m., and a maximum piston travel of 200 ft. per min.;

Steam pressure of 175 lb. gauge at the engine throttle;

Modified steam jacketing and reheating;

Moderately superheated steam by independent apparatus;

Smoke-flue reheating;

Water-tube boilers fitted with mechanical stokers;

Natural draft of at least 0.8 in. of water;

Feed-water economizers and automatic damper regulators;

Coal bought on the basis of 14,000 B.T.U. per lb.;

Boiler efficiency of 75 per cent.;

Coal consumption per I.H.P., 1 lb. for large plants and 1.75 lb. for small plants;

Maintenance of engines, 1.5 per cent. for large plants and 3 per cent. for small plants.—The above information was condensed from a paper by Charles A. Hague, read before the American Society of Civil Engineers, May 17, 1911, and printed in the March, 1911, Proceedings of the Society.

CANADIAN CHARTERS FOR FOREIGN ENTERPRISES.*

Barcelona Traction, Light and Power Company, Toronto, $40,000,000.

Mexican Midland Light and Power Company, Toronto, $15,000,000.

Vancouver Harbor and Dock Extension Company, Vancouver, $10,000,000.

Ebro Irrigation and Power Company, Toronto, $2,500,000.

Royal Dome Gold Mines, Hamilton, $2,000,000.

Reciprocity Mines of Porcupine, Toronto, $1,000,000.

Land Corporation of Canada, Winnipeg, $1,000,000.

Graham Island Oil Fields, Prince Rupert, $1,000,000.

Eight companies this week account for an aggregate of authorized capital amounting to $72,500,000. Three of these are responsible for $65,000,000. The Barcelona Traction, Light and Power Company, capitalized at $40,000,000, divided into 400,000 shares of $100 each, has received a Dominion charter giving it power to develop and sell electrical energy. The Ebro Irrigation and Power Company, Limited, has obtained very similar powers in a Dominion charter. Its capital is $2,500,000 divided into 25,000 shares of $100 each. Both companies have their head offices in Toronto and members of the legal firm of Messrs. Blake, Lash, Anglin and Cassels are noted as the provisional directors.

The Mexican Midland Light and Power Company, Limited, with capital of $15,000,000 divided into 150,000 shares, has received an Ontario charter, giving the company power to carry on outside of Canada the business of an electric light, heat and power in all its branches. Among the provisional directors are Mr. T. M. Sanders, civil engineer, and Mr. F. J. Robinson, electrical engineer, of London, England. Mr. T. H. Kilgore, of Toronto, and Mr. E. C. Boeckh, president and general manager of Boeckh Brothers, Limited, brush manufacturers, Toronto, are also directors.

Two big Porcupine companies have been formed, the Royal Dome, while the other bears the appropriate name Reciprocity. The Grasselli Chemical Company, with capital of $250,000, has been granted an Ontario charter with head office at Hamilton. This is a branch of the American firm of the same name which has its headquarters in Cleveland, Ohio. Evidence of further activity in Northern Ontario is seen in the incorporation of the New Ontario Timber and Trading Company. Real estate movements are reflected in the chartering of the Humber Land Company at Toronto, and the Land Corporation of Canada at Winnipeg. Mr. E. M. Carroll is a director of Wright and Carroll Investments capitalized at $100,000, with headquarters at Toronto.

From The Monetary Times

MUNICIPAL ENGINEERING AS A PROFESSION.*

By B. WYAND.

There no longer exists the need to drive home the fact that municipal engineering is a distinct profession. There was a time when the statement would have been met with a shrug of the shoulder or a curl of the lip. To-day no dispute is possible. The profession is recognized universally, and its separate existance is proved in that the legislature is the one notable exception that has not yet awakened to the fact that this very lusty infant is among us and is making vigorous outcry for its rights. The pedigree of this interesting infant is lost in obscurity. Road foremen, inspectors of nuisances, village grocers, ex-policemen, drapers and civil engineers of the old school are among its pregenitors, and it is possible that each of these crossings has had its healthy influence upon the matured product.

I am not going to weary you with any of the clap-trap which is talked about the nobility of the profession. Paragraphs on this read well as the peroration to a presidental address, but they mean nothing. Every useful profession honestly practised is as noble as any other, and, after all, men do not usually enter professions simply because they are noble. A means of livelihood is the first need, and opportunity finds it for us. There is certainly no profession in which the possibilities of doing good to one's fellows are so great as that of municipal engineering, but it can scarcely be claimed that the engineer had that fact in view when he competed for his appointment. The inspector of nuisances stands in the same position, and the soft sawder of the professional sanitarian is obvious. To speak of the inspector as a hero who girds on his armour and goes forth to fight the battle in the high cause of humanity is, again, just merely clap-trap. I have met inspectors whose ideals were not quite so high as this.

While speaking of the sanitary inspector a few words on his behalf may be said. There are, of course, inspectors whose sole work is to carry out the orders of the medical officer of health. They are a kind of sanitary police, in whom the organ of smell is popularly supposed to be abnormally developed. They call on cases of infectious disease, and may possibly convey the various complaints wholesale about the district—precisely as the doctor may do. No precautions are taken, and the inspector goes cheerfully from small-pox to diphtheria, from diphtheria to scarlet fever, and so on, calling by the way for refreshment and physical sustenance. His lengthy journeys in rural districts compel this, and I am finding no fault with him. His other duties are to investigate complaints, and to furnish his medical officer of health with sufficient detail to make a formidable report to be prepared and signed by the latter gentleman. There is, however, another class of inspector whose duties include the planning and supervising of engineering works. He is mostly known as a sanitary engineer, although no such appointment is officially recognized. The word "sanitary" is, however, damning, and he is regarded as quite inferior to that official whose whole duties may consist of the maintenance and repair of macadam and gravel or flint highways. The matter is one well worth the consideration of the profession in general, and the hand of fellowship should not be refused simply because of the restricted definition of a word which really embraces very much.

Municipal engineering is a profession which will some day be found to have usurped the whole field of engineering, except that form known as Government engineering. The consultant will, I am afraid, have a very bad time; but the inevitable has to be faced. As matters are now, the municipal man is not encouraged to prepare schemes of any magnitude, and many who are really capable—there are, of course, quite as many (if not more) who are not capable—conceal their knowledge. There is always trouble about payment where the salaried officer is concerned, and when a fee is arranged it is usually only a proportion of that which the consultant would be paid. Honorariums are merely a means to an end—the end being the payment of an amount equal to about one-tenth of that which is morally due. To come back to my point, however. In every direction now municipal trading is being extended. Municipal schemes to run means more responsibility for the officer, and the necessity for a better class of officer—a more highly-trained and more intelligent man. This, again, means higher salary, larger staff, and better accommodation, together with the less frequent requisitioning of the consultant. It may be urged that never was the consultant so in evidence as during the last few years. It is quite true, but it has to be remembered that he is largely engaged in installing first schemes. Extension will not, in scores of cases, go to him; for the necessity for a highly-trained man to run a concern does away with the necessity for another highly-trained man to repeat, to improve or to extend what has already been done.

There has been much talk of late about improving the status of the profession. The term is a misleading one. What is wanted is to improve the status of the members of the profession, and every man who realizes that he is an adviser, and not a servant, is working on right lines. Municipal engineers must realize their own importance. I do not mean that they should cultivate deep voices and contort themselves into ponderous attitudes. I mean only that they must feel their responsibilities, and recognize the fact that supremacy is their place in local life. Even the chairman of the council is merely a cipher when contrasted with the municipal engineer, and he should, as far as possible, be made to feel this. The chairman may be the better man in many ways, but when it comes to engineering he should be made to recognize the fact that he must play fourth fiddle, and must feel happy that he has not been relegated to the orchestral triangle. A man is estimated in this world much at the value he places upon himself, and the humble, shrinking individual who is led by his council is never likely to command either respect or a periodical increase of salary. The blatant gentleman who boasts freely is much more likely to succeed for a time, but his day is not usually a long one, and he is the last man to make capital out of a reverse of fortune.

I will say nothing harsher of councillors than that they are entirely unnecessary, and I am sadly afraid that security of tenure will be difficult of attainment so long as district councils exist. It is not to be expected—it would be foreign to human nature—that councillors would welcome the continued services of a man with whom they had quarrelled, and of whose services they had endeavored to rid themselves. The life of the officer would be a miniature hell; indeed

*A paper read at a Western District Meeting of the Institution of Municipal Engineers held at Worcester on Saturday, July 15th, 1911.

things would be made so unpleasant for him that he would welcome resignation. There is a popular fiction current to the effect that the sanitary inspector is protected by the local government board. He has no more real protection than the surveyor, and councils may do as they please with him. The sole duty of the council should be the making of the rate, and this could be as well done by one man as by twenty—the collector could, in fact, do it. Directly a council concerns itself on engineering matters it becomes ridiculous, and the effect of its interference is to hamper the technical officers. These should be appointed by a central controlling authority, and should be removable only for misconduct, or at an age when a pension (and a sufficient one) falls due. Their appointment would, in fact, be a life one, with promotion to larger appointments as vacancies occur. They would be responsible to the central department only, just as are police and post-office officials. What would happen were these classes appointed and dismissed at the pleasure of small local bodies? Perhaps, when councils no longer exist, the municipal engineer will be appreciated at his true worth. Until then but little can, I fear, be done.

The question of salaries is all-important. Municipal engineers are usually woefully underpaid and overworked. Higher salaries and less hours of labor would reduce the ranks of the unemployed, and the overcrowding question would not recur for years. There would be room for thousands if proper and sufficient staffs were engaged. £150 a year should be the minimum salary for even a deputy or chief assistant.

The full qualifications for a municipal engineering appointment are so many and so varied that no one man could satisfy a standard. The essential qualifications would place no light tax on a man's abilities, and none should be appointed without these. Some towns have, I believe, passed resolutions to the effect that no man should be appointed who has not passed the examination of the Institution of Civil Engineers qualifying for at least associate membership. This is, of course, pure nonsense; indeed, so far as municipal engineering goes, the examination is three-fourths sheer waste of time. While there are special examinations for municipal engineers, it is as ridiculous to ask a man to pass another as it would be to ask a judge to pass in surgery because he might on some occasion have to hear an action in which a broken leg was introduced. That some limitation should be imposed upon the appointment of quite unqualified men no one will deny, but it is equally important that the test to be undergone shall be a reasonable one. It is to be hoped that councillors will not allow themselves longer or to any further extent to be hoodwinked by men whose interest is with an alien profession. It must not be forgotten either—and I cannot lay too great a stress upon it—that civil engineering as practised is only one branch of municipal engineering. A calculating boy or similar wonder need not necessarily make a good municipal engineer.

I have no hesitation, in conclusion, in placing municipal engineering at the top of all the professions. It is one in which the duffer can never shine, and there is no other profession of which this can be said, except, perhaps, that of the barrister, and he, unless possessed of special talent, has no chance unless he be promoted to the Bench. The time has arrived when the municipal engineer must take the place which is his by right, and with two active bodies to voice his interests, both working now upon similar lines, great strides must inevitably be made during the next decade or two. Individual effort is, however, none the less necessary.

CIVIC PORTION OF STREET RAILWAY EARNINGS.

The franchise which gives the Toronto Street Railway Company running rights on the thoroughfares of this city calls for a percentage of the receipts to be turned over to

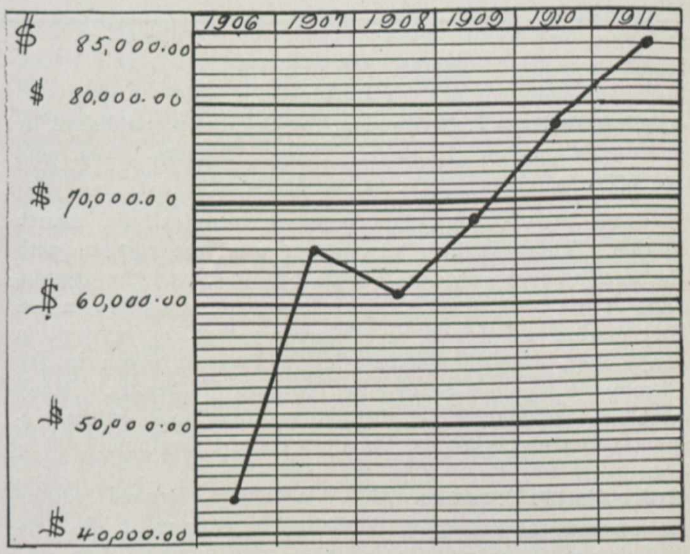


Fig. 1.

the council. The curve shown in Fig. 1 illustrates the manner in which this sum has grown in six years. The comparison is made in the month of August of each year.

RAILROAD AND COMPANY EARNINGS.

The net earnings of the Regina municipal railway for August, inclusive of the 29th and 30th of July, amount to $4,390.02. The number of passengers carried was 151,104, and the cars travelled 12,815 miles. The railway's gross earnings were $7,718.50, while the operating expenses amounted to $3,328.48. The gross earnings per car mile were $60.23, and the net earnings per car mile, $34.26.

The Lake Superior Corporation has issued its annual report for year ending June 30th, 1911. It shows that the yearly operations of the subsidiary companies resulted in a surplus of $1,200,216, subject to depreciation and other charges. The output of the steel plant compares with 1910 as follows:—

	1910.	1911.
Pig-iron	$53,528	$170,359
Steel rails	201,615	208,283

The Camaguey Company earnings for August show an increase in gross of 17 per cent., while the gain in net is nearly 28 per cent. over the same month of the previous year. Gross for the eight months ended August 31st shows an advance of 14.58 per cent. over the corresponding period of last year, and net is 29.39 in excess of the figures for the similar period of the year preceding.

Following are the figures in detail:—

	1910.	1911.	Inc.
Gross	$11,749	$13,751	$2,002
Net	5,691	7,267	1,576

The Cuba Railway Company earnings for July were as follows:—

	1911.	1910.	Inc. or dec.
July gross	$262,666	$233,441	+ $29,225
Net	119,352	118,433	+ 919
Surplus after chgs.	59,227	81,766	— 22,539

ENGINEERS' LIBRARY

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

BOOK REVIEWS.

Applied Statics.—T. R. Loudon, fourth edition, published by the Canadian Engineer Press, Toronto. 164 pp., 6¼ x 9. Many cuts; price, $1.50.

This little volume has now arrived at the fourth edition. There is little change in this last edition, with the exception of new cuts. This has improved the appearance of the book a good deal. It was the intention in the first edition, to provide an elementary text, to be used in conjunction with the lectures on statics, as given in the Faculty of Applied Science at Toronto University. Many problems are introduced throughout the book of an elementary nature, as it is intended for the beginner.

Hydro-Electric Practice.—H. Von Schon, second edition revised and enlarged, published by Messrs. J. B. Lippincott Company, Philadelphia and London. 383 pp., 7½ x 10; fully illustrated; price $6.00.

In this second edition the revision consists mainly of a detailed treatment of the market, flow, discussion, pondage, and storage, of Part I.; of development, scope and equipment in Part II., and of Part III, "Operating and maintaining the Plant." The author says that the tables of rivers' drainage areas and low run-off of navigable rivers, and the forms of government permits and licenses, have been taken out to make room for the above valuable matter, and because this information may now be readily obtained from government publications.

The book is well arranged, well written, with numerous and good illustrations. It presents some very good information in connection with low-head turbine installations of the open canal type, with details of many of the appurtenances, such as head gates, racks, etc. The book in some other respects is weak. For instance, the selection of the turbine and the regulation of the plant, is treated in a very cursory manner, indeed. The mathematical treatment of the problems throughout are not good.

On the other hand, the book forms a valuable addition to engineering literature in its treatment of the commercial side of hydraulic problems, with its analyses of cost of development and investigation of the market; and as such will be well received by the financier, the promoter and the engineer.

Mathematics for the Practical Man.—By George Howe. Published by the D. Van Nostrand Company, New York. 144 pp.; 5 x 8; price $1.25.

In preparing this work the author says that he has been prompted by the following reasons:

The dearth of short but complete books covering the fundamentals of mathematics, and the tendency of those elementary books to treat the subject in a popular rather than in a scientific manner.

The book is one which should be in the possession of all engineers who have not had an opportunity to profit by a course of mathematics in regular and technical schools. The text is confined to fundamentals of algebra, geometry, trigonometry, logarithms, co-ordinate geometry and the elementary principles of the calculus.

It is written in a very simple and concise manner and the problems attached to each chapter, with their solutions, form a valuable addition to the book, making it a valuable one for the man to whom it is designed to aid.

The Second Report of the Joint Committee of Reinforced Concrete.—The second report of the Joint Committee of Reinforced Concrete, formed under the auspices of the Royal Institute of British Architects, forms a volume of 48 pages. The report is the work of the Committee formed from the different technical societies in Great Britain, and should form an absolute essential in the library of any one interested in the subject of reinforced concrete.

In the explanatory note the Joint Committee say that their section on materials has been modified in certain details compared with the report of 1907. The section on methods of calculation has been recast in form, and the standard notation proposed by the Concrete Institute has been adopted. The sub-section on columns has been revised, and the formulae proposed have been recast, so as to include the cases in which the lateral or helical binding is a material factor in the strength.

There are eight appendices to the report, and their titles are as follows:

Calculations for Singly Reinforced Beams.

Shear Stresses in Reinforced Concrete Beams.

The Strength of Rectangular Slabs.

Strength of Pillars.

The Moment of Inertia of Sections of Reinforced Concrete.

Tensile and Shearing Stresses in Web Reinforcement.

Bach's Theory of the Resistance of Flat Slabs Supported on all Edges and Uniformly Loaded.

Comparison of the Results Given by Various Rules for the Strength of Flat Rectangular Slabs Supported on all Edges and Uniformly Loaded.

We have just finished publishing this report in full in the columns of the Engineer, with the exception of the appendices, as noted above. This report can be obtained from the office of the Joint Committee, Royal Institute of British Architects, 9 Conduit Street, Regent Street, London, England, at the price of one shilling.

Chemists' Pocket Manual.—Richard K. Meade, M.S. Published by William's and Norgate, London, Eng., and the Chemical Publishing Co., Easton, Pa. 443 pp., 4 x 6; 39 illustrations, price $3.00.

In issuing this (the second edition), the author has rearranged the subject matter. Many new tables have been compounded and added, and the analytical methods have been increased by much new and useful material. This little book would doubtless prove of value to the plant chemist and the chemical engineer, presenting as it does much matter and material that is usually found in appendices of manuals on chemistry and chemical analyses, among which might be mentioned weights and measures, mathematical matters, international atomic weights, stoichiometry, calibration of chemical glassware, heat, combustion, assaying, select methods for technical analyses. The list of tables includes temperature, mineralogy, conversion tables, specific gravities of solids and liquids, weight and volume of substances. The volume is nicely bound in leather and the size is convenient for carrying in the pocket.—L. B. J.

Practical Applied Electricity.—By David Penn Moreton, B.S., E.E. Flexible leather, 4½ x 7¼.; 450 pp.; 323 illustrations and many tables. Published by the Reilly & Britton Co., Chicago. Price $2.00.

This book is intended primarily for those who are desirous of obtaining a practical knowledge of the subject of electricity, but are unable to take a course of instruction in electrical engineering at a college or university. Nothing new in the explanations of the phenomena and apparatus involved, are given, and for that reason the book is better adapted to its purpose.

The author presents his explanations very clearly and concisely, and the book is a decided improvement over many of the practical books that have appeared recently, both in the matter of text and illustrations. The author mainly deals with discussions of direct current, leaving the presentation of alternating currents to the end.

This book will form a valuable addition to the library of persons who desire to obtain a practical knowledge of the subject of electricity, but who are unable to take a complete course.

Oil Analysis.—Augustus H. Gill, published by Messrs. J. B. Lippincott Co., London and Philadelphia. 188 pp.; 5½ x 8½; fully illustrated; price $2.00.

This work is designed primarily for the advanced student in analysis, as assumption is taken that the reader is familiar with volumetric and gravimetric work and possesses some knowledge of organic chemistry.

The descriptive text includes concise methods of making determinations on petroleums, animal and vegetable oils, waste fats and lubricating grease. The volume is divided into two main portions, Part I. closing with a chapter on "General considerations regarding lubricants"; Part II. deals in a specific manner with a number of oils and their peculiarities, and it may be said that this list includes all the principal oils of commerce. An appendix follows in which are presented tables and curves, as well as specifications for reagents. Among the tables are the requirements of various United States cities, flash and fire test of various oils, flash points of certain organic compounds, the specific gravity, Degrees Baume, and weight per gallon and per cubic foot of certain oils, and the principal constants of various oils.—L.B.J.

A bulletin has recently been published by the Bureau of Mines, Washington, D.C., dealing with the essential factors in the formation of producer gas.

It is the joint endeavor of J. K. Clement, L. H. Adams and C. N. Haskins. The work is descriptive of some original and interesting investigations, and in the opening sections a useful electric furnace is described, together with a means of constructing same; this apparatus is employed to produce a uniform temperature on which to determine the precise thermal conditions most favorable to the formation of H. and Co.

This booklet demonstrates the inadvisability of operating gas producers at a temperature above 1300°C.

The rear portion of the book contains some information on "Effective Temperature for Water-Gas Generation." This bulletin is known as No. 7.—L. B. J.

Kinetic Theory of Engineering Structures, Dealing with Stresses, Deformations, and Work for the use of Students and Practitioners in Civil Engineering.—By David A. Molitor, C.E., McGraw-Hill Book Co., New York, 1911. Cloth 7 x 9; 366 pp., including index. Many diagrammatic illustrations and several tables. Price $5.00.

When engineers in this country set out to design a framed structure, they make a very careful and complete analysis of the various stresses in the individual members by means of static determinations. For a number of years designers abroad, especially in Germany, have employed a method of stress analysis in which an elastic structure is treated as a mechanical contrivance in motion, on the application of an external load, and not as an inelastic body at rest. The soundness of such a theory is evident and the actual stresses can be worked out analytically on the basis of virtual work performed on and by the members of any structure, due to the elastic properties of the material and in accordance with the direct ratio existing between deformation and stress within the elastic limit.

Mr. Molitor devotes the first eleven chapters of the above volume to an exposition and analysis of this "Kinetic" theory, and the only criticism that might be offered is one which is common to many works where long and involved mathematical operations are carried forward, and that is a tendency for the actual meaning of the various relations to become obscured when worked up from long lists of symbols. One chapter of the book is given over to a study of stress analysis by methods of statics, and while rather short, is a remarkably clear exposition of such treatment, especially that portion referring to live load stresses. Secondary stresses due to the weight of individual horizontal and inclined members, producing bending, stiffness at panel points, and eccentric connections, as well as dynamic stresses, due to wind, tractive effort, impact, etc., are also carefully analysed, and the author makes several very valuable observations regarding practical features in carrying out designs in order to eliminate secondary stresses as far as possible. The final chapter of the book, after discussing and analyzing the elastic theory for masonry arches, takes up in detail the design of a 150-foot concrete arch.

Mr. Molitor generously gives credit for much of the work to various authorities and lists many works of reference on the subject.—M. V. S.

The Principles of Scientific Management.— Frederick Winslow Taylor, Past President Am. Soc. M.E. Published by Harper and Bros.; 5¾ x 9 inches; 144 pages.

We here have a book presented by a man who has devoted thirty years of his life to developing "Scientific Management." After serving an apprenticeship as a pattern maker and machinist, he entered the machine shop of the Midvale Steel Co. as a laborer, but soon after became clerk of the shop, then machinist and gang boss. Here he noticed the great fault of the American workman, of "soldiering" on the job and began his life work of getting a fair days work out of every man and every machine.

He states that the book has been written:

"First. To point out, through a series of simple illustrations, the great loss which the whole country is suffering through inefficiency in almost all of our daily acts.

"Second. To try to convince the reader that the remedy for this inefficiency lies in systematic management, rather than in searching for some unusual or extraordinary man.

"Third. To prove that the best management is a true science, resting upon clearly defined laws, rules and principles, as a foundation. And further to show that the fundamental principles of scientific management are applicable to all kinds of human activities, from our simplest individual acts to the work of our great corporations, which call for the most elaborate co-operation. And, briefly, through a series of illustrations, to convince the reader that whenever these principles are correctly applied, results must follow, which are truly astounding."

The labor problem of to-day is caused by the belief that the interests of employee's and employers are antagonistic, but the very basis of scientific management is the belief that the maximum prosperity of one must be coupled with that of the other to endure. This means higher wages for the workman and greater dividends for the employer, due to decreased cost of production. A great many men are deliberately limiting their daily production and others, with the best of intentions, are far from efficient.

Mr. Taylor gives three causes for this condition:

"First. The fallacy, which has from time immemorial been almost universal among workmen, that a material increase in the output of each man or each machine in the trade would result in the end in throwing a large number of men out of work.

"Second. The defective systems of management which are in common use and which make it necessary for each workman to soldier or work slowly, in order that he may protect his own best interests.

"Third. The inefficient rule-of-thumb methods, which are still almost universal in all trades, and in practising which our workmen waste a large part of their effort."

He does not claim that his system will be a panacea for all the troubles of working people or of employers, but that it will relieve the duration of the periods of depression and the suffering of both classes to a certain extent. In his own words, "Scientific management fundamentally consists of certain broad principles, a certain philosophy, which can be applied in many ways, and a description of what any one man or men may believe to be the best mechanism for applying these general principles, should in no way be confused with the principles themselves."

Mr. Taylor warns against making the error of mistaking the mechanism of the system for its essence, and gives as the elements of the mechanism:

"1. Time study, with the implements and methods for properly making it.

"2. Functional or divided foremanship and its superiority to the old-fashioned single foreman.

"3. The standardization of all tools and implements used in the trades, and also of the acts or movements of workmen for each class of work.

"4. The desirability of a planning room or department.

"5. The 'exception principle' in management.

"6. The use of slide rules and similar time-saving implements.

"7. Instruction cards for the workman.

"8. The task idea in management, accompanied by a large bonus for the successful performance of the task.

"9. The 'differential rate.'

"10. Mnemonic systems for classifying manufactured products as well as implements used in manufacturing.

"11. A routing system.

"12. Modern cost system, etc., etc."

The text is largely taken up with illustrative cases, varying from the simplest to the more intricate forms of labor. The famous pig-iron case illustrates its application to a class of labor of the lowest type. A gang of men who had been loading pig-iron on cars at the rate of 12½ long tons per day per man, were made to load 47 tons, by working them in the most efficient manner. It was found that for the minimum tiring effect on a man handling pigs weighing 92 pounds, he should be under load 43 per cent. and free from load 57 per cent. of the time. He should even sit down and rest at regular intervals, a thing which under the old system would have been cause for immediate discharge.

At the Bethlehem Steel Co.'s plant, a large number of tests were made on the relation of the size and shape of shovel to the amount of material handled, and as a result eight to ten different kinds of shovels were provided. The men unloading iron ore under the new system adopted, were able to earn more at 3.2 cents than elsewhere at 4.9 cents per hour.

Mr. Frank B. Gilbreth applied the principles of scientific management to brick laying and made a very careful study of the motions required in the operation. By standardizing the tools and eliminating all unnecessary movements, a man was able to lay 350 bricks per hour, whereas the average speed with the old methods was 120 bricks per man per hour. Other cases cited are the inspection of the output of a factory manufacturing steel balls and the results attained in a factory making a standard machine, where the output had been within three years, more than doubled per man, and per machine, and the average increase in earnings of each man was about 35 per cent.

All this was accomplished by applying "the four elements which constitute the essence of scientific management."

"First. Developing a science for each element of a man's work to replace the old rule-of-thumb method.

"Second. Scientifically selecting and then training and developing the workman; whereas in the past he chose his own work and trained himself as best he could.

"Third. Heartily co-operating with the men so as to insure all of the work being done in accordance with the principles of the science which has been developed.

"Fourth. Dividing the work and the responsibility between the management and the workman. The management taking over all work for which they are better fitted than the workman.

He warns against attempting to adopt the system too rapidly, as the change from the old to the new system is too radical and involves not only physical changes in the plant, but a complete change in the mental attitude and habits of the management as well as of the workman. He gives a case where the sudden change brought on a strike and finally a complete failure.

The book deserves, and will, no doubt, be widely read. The principles set forth in it can be applied to a great many lines of work other than those in which they have been developed, and will unquestionably do a great deal toward improving our national efficiency.—H. J. C.

PUBLICATIONS RECEIVED.

The Monthly Peat Report.—Souvenir and presentation number to commemorate the organization of the Peat Association of Canada, Vol. 1, No. 1, September, 1911. Published monthly and distributed free by the Peat Association of Canada.

Descriptive Catalogue of the Road Model Exhibit.—The office of Public Roads, U. S. Department of Agriculture, have just issued their bulletin No. 36, illustrating the road model exhibited at the Alaska-Yukon-Pacific Exposition.

Monthly Reports of the Department of Trade and Commerce, published by the Department of Trade and Commerce of Canada.

Imports Entered for Consumption.—The unrevised monthly statements compiled at the Customs Department, Ottawa.

The Report of the Chief Engineer of the City of New York.—This is a report of the Chief Engineer of the Board of Estimate and Apportionment delivered for the year 1910.

Proceedings of the American Institute of Architects, being the proceedings of the Forty-fourth Annual Convention held at San Francisco and Los Angeles, Cal.

The Fifth and Sixth Reports of the Bureau of Archives, issued by the Province of Ontario, and edited by Alexander Fraser, Provincial Archivist.

CATALOGUES RECEIVED.

Core Drills.—McKiernan-Terry Drill Co., 115 Broadway, New York. Catalogue; pp. 69; illustrated.

The McKiernan-Terry core drills to which this catalogue is devoted, are suitable for various classes of work, such as prospecting, testing, blasting, etc. The various classes of these drills are described and illustrated and instructions are given for operation. A large portion of the catalogue is devoted to reviews of the operations accomplished by the Mc-Kiernan-Terry core drills for the purpose of providing users and prospective users with such details as to facilitate intelligent purchasing. These drills will drill up to 45° from the vertical and give cores up to 30 inches in diameter.

Bitumens.—The Good Roads Improvement Company forward a four-page pamphlet entitled, "Applying Bitumens Hot or Cold," illustrating steel tank wagons equipped with heater. Copies may be obtained by writing the General Office, First National Bank Bldg., Cincinnati, Ohio.

Filters.—The Roberts Filter Manufacturing Company issued a small bulletin for distribution at the Dominion Exhibition held at Regina, Sask., August 1st to 12th, 1911, which shows different views of Saskatchewan Water Works System installed by Roberts Filter Company.

Structural Steel.—The Canada Steel Company, of Hamilton, Ont., have issued a booklet showing different bars and structural steel shapes manufactured by them.

Concrete Sidewalks.—The Berger Manufacturing Company, Canton, Ohio, forward catalogue illustrating their pressed steel forms for concrete sidewalks. This makes a very interesting booklet on sidewalk construction.

Hydraulic Turbines.—The S. Morgan Smith Company, York, Pa., have forwarded a pamphlet illustrating the different turbines manufactured by them and including directions for the construction of head and tail races, and setting of the wheels, with some valuable tables attached.

Hydraulic Cranes.—The Hydraulic Engineering Company, Ltd., Chester and London, have just issued the fourth edition of their catalogue illustrating different hydraulic machinery. It is a very well bound book of 182 pages, excellently printed and finely illustrated, showing hydraulic coal hoists, wagon hoists, cranes suspended, hydraulic lifts and pumping engines, and a variety of other hydraulic appliances.

Crude Oil Engines.—The Atlas Engine Works, of Indianapolis, have just issued their bulletin No. 201, illustrating Atlas Crude Oil Engines and the Diesel type, also a report on the test of one of these engines by the consulting engineer of Chicago.

The Mesta Machine Company.—A description of the plant of the Mesta Machine Company, with a schedule of trip to the works of this company, by the American Society of Mechanical Engineers. This little pamphlet is gotten out as a souvenir for the members of the American Society of Mechanical Engineers. present on this trip. A number of fine illustrations of different parts of their works with some of the machines that they have completed, are given.

Pile Hammers.—The McKiernan-Terry Drill Company have sent out a 16-page pamphlet with many illustrations of the different types of their pile hammers being used on different classes of work. Copies of the pamphlet may be obtained from McKiernan-Terry Drill Co., 115 Broadway, New York.

Hydraulic Pumps.—Catalogue No. 81, is the title of a new 120-page 6 x 9 pamphlet descriptive of many standard and several new types of hydraulic pumps. This catalogue, issued and sent free by the Watson-Stillman Co., 50 Church Street, New York, contains valuable information for hydraulic engineers and users of hydraulic machinery.

Continuous Reading Calipers.—The Blanchard Machine Company, Cambridge, Mass., have just issued a pamphlet descriptive of the newly designed "Blanchard Continuous Reading Caliper" or "Excess Stock Indicator." The many advantages of the Blanchard method are made evident by the pamphlet, which will be sent on request to the company.

REINFORCING WOODEN POLES.

The overhead department of the Indiana Union Traction Company, Anderson, Ind., this year is reinforcing about 1,600 of its trolley poles. Last year about 700 poles were reinforced and during the late fall of 1909 similar work was done on 250 to 300 poles. The work is in charge of G. H. Kelsay, superintendent of power.

An excavation to a depth of 24 in. to 28 in. is first made around the pole. The rot around its base is then shaved off, and a thorough application of creosote is given the pole from the bottom up to a height of 3 ft. or 4 ft. above the ground. For installing the concrete reinforcement thirty-six forms, 48 in. long and ranging in diameter from 18 in. to 24 in., are used. These are constructed of black sheet iron and are made in semi-circular halves. Semi-circular bands are riveted to the iron to hold the forms in shape, the edges of the forms being hinged together, thus permitting easy handling and assuring that halves of the same size are kept together. With thirty-six forms four men can be kept busy concreting.

A form of the size most nearly conforming to the size of the pole is laid around it, and inside this form is placed wire reinforcement consisting of 46-in. twelve-bar heavy wire fence, with No. 7 top and bottom wires, No. 9 intermediate horizontal wires and No. 9 vertical wires spaced 3 in. apart. This fencing is cut in lengths sufficient to encircle the pole and be embedded in the concrete just inside the forms. The form is then filled with concrete consisting of one part cement to five parts gravel and sand. The top is sloped off slightly to assist in shedding water from the top of the concrete and around the pole. The form is removed from the pole after about twenty-four to thirty-six hours. After the forms have been removed the dirt is tamped in around the concrete and the pole is coated with a heavy paint or pitch compound around the top of the concrete to eliminate as nearly as possible the entrance of moisture between the concrete form and the pole.

The reinforcement is being applied to 30-ft. and 40-ft. poles, although the latter size poles are thought to be good for a considerable length of time. The 30-ft. poles, however, are believed to be near the maximum limit of their life without some form of protection and therefore reinforcement, as described, has been applied.

PERSONAL.

Mr. J. M. R. Fairbairn has been appointed to the position of assistant chief engineer of the eastern lines of the Canadian Pacific Railway. Mr. Fairbairn was born at Peterborough, Ont., and received his education in the local schools and the Collegiate Institute. His mother was the daughter of the late Rev. J. M. Roger.

Mr. Howard Murray, treasurer of the Shawinigan Power Company, is president of the New Canada Carbide Company, which is a consolidation of the Wilson Carbide Company, the Ottawa Carbide Company, and the Shawinigan Carbide Company.

COMING MEETINGS.

ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Oct. 3, 4, Montreal. F. S. Baker, President, Toronto; Alcide Chausse, Hon.-Secretary, 5 Beaver Hall Square, Montreal, Que.

INTERNATIONAL MUNICIPAL CONGRESS AND EXPOSITION.—Sept. 18-30. Chicago, Ill. Curb M. Treab, Secretary, Great Northern Buiding, Chicago, Ill.

FOURTH ANNUAL GOOD ROADS CONGRESS.—Sept. 18-Oct. 1. Chicago, Ill. J. A. Rountree, Secretary, Birmingham, Ala.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Sept. 26-29. Grand Rapids, Mich. A. Prescott Folwell, Secretary, 239 West Thirty-ninth Street, New York City.

AMERICAN ASSOCIATION FOR HIGHWAY IMPROVEMENT.—Nov. 20-24. First Annual Convention, Richmond, Va. Logan Waller Page, President, United States Office of Public Roads, Washington, D.C.

THE CANADIAN PUBLIC HEALTH ASSOCIATION.—Nov. 21-23, Montreal. F. C. Douglas, M.D., D.P.H., Secretary, 51 Park Avenue, Montreal.

ENGINEERING SOCIETIES.

CANADIAN SOCIETY OF CIVIL ENGINEERS.—413 Dorchester Street West, Montreal. President, C. H. Rust; Secretary, Professor C. H. McLeod.

QUEBEC BRANCH—
Chairman, P. E. Parent; Secretary, S. S. Oliver. Meetings held twice a month at Room 40, City Hall.

TORONTO BRANCH—
96 King Street West, Toronto. Chairman, H. E. T. Haultain; Secretary, A. C. D. Blanchard, City Hall, Toronto. Meets last Thursday of the month at Engineers' Club.

MANITOBA BRANCH—
Secretary E. Brydone Jack. Meets every first and third Fridays of each month, October to April, in University of Manitoba, Winnipeg.

VANCOUVER BRANCH—
Chairman, Geo. H. Webster; Secretary, H. K. Dutcher, 319 Pender Street West, Vancouver. Meets in Engineering Department, University.

OTTAWA BRANCH—
Chairman, A. A. Dion, Ottawa; Secretary, H. Victor Brayley, N. T. Ry., Cory Bldg.

MUNICIPAL ASSOCIATIONS.

ONTARIO MUNICIPAL ASSOCIATION.—President, Chas. Hopewell, Mayor, Ottawa; Secretary-Treasurer, Mr. K. W. McKay, County Clerk, St. Thomas, Ontario.

UNION OF ALBERTA MUNICIPALITIES.—President, H. H. Gaetz, Red Deer, Alta.; Secretary-Treasurer, John T. Hall, Medicine Hat, Alta.

THE UNION OF CANADIAN MUNICIPALITIES.—President, W. Sanford Evans, Mayor of Winnipeg; Hon. Secretary-Treasurer, W. D. Lighthall, K.C., Ex-Mayor of Westmount.

THE UNION OF NEW BRUNSWICK MUNICIPALITIES.—President, Mayor Reilly, Moncton; Hon. Secretary-Treasurer, J. W. McCready, City Clerk, Fredericton.

UNION OF NOVA SCOTIA MUNICIPALITIES.—President, Mr. A. E. McMahon, Warden, King's Co., Kentville, N.S.; Secretary, A. Roberts, Bridgewater, N.S.

UNION OF SASKATCHEWAN MUNICIPALITIES.—President, Mayor Hopkins, Saskatoon; Secretary, Mr. J. Kelso Hunter, City Clerk, Regina, Sask.

CANADIAN TECHNICAL SOCIETIES.

ALBERTA ASSOCIATION OF ARCHITECTS.—President, G. M. Lang; Secretary, L. M. Gotch, Calgary, Alta.

ASSOCIATION OF SASKATCHEWAN LAND SURVEYORS.—President, J. L. R. Parsons, Regina; Secretary-Treasurer, M. B. Weeks, Regina.

ASTRONOMICAL SOCIETY OF SASKATCHEWAN.—President, N. McMurchy; Secretary, Mr. McClung, Regina.

BRITISH COLUMBIA LAND SURVEYORS' ASSOCIATION.—President, W. S. Drewry, Nelson, B.C.; Secretary-Treasurer, S. A. Roberts, Victoria, B.C.

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