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Volume 25 Toronto, July 31, 1913 Contents of this issue on page 245

The Canadian Engineer

An Engineering Weekly

THE DESIGN OF CENTRAL HEATING SYSTEMS

PART III.

THE UNDERGROUND TRANSMISSION SYSTEM CONTINUED—FORMS OF CONDUIT IN USE AND THEIR COMPARATIVE COSTS—THERMOSTATIC CONTROL

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The method of installation of the piping system and its protection must be of such a character that settlement of the trench or the pressure of the earth will not cause the pipe to become out of level or alignment. The pipe must be free to expand and there must be no restriction to this movement or some parts shall surely fail. The insulating material and the conduit itself which protects the pipe must be of such a nature that it will not be affected by temperature changes in the pipe or in the earth. Otherwise cracks in the conduit will occur. These cracks allow water to seep in and not only to destroy the insulating material, but also to increase the line losses. All steam pipes should be carefully graded to the low points of the system where automatic steam traps should be placed in the manholes to remove the condensed steam and discharge it into sewers.

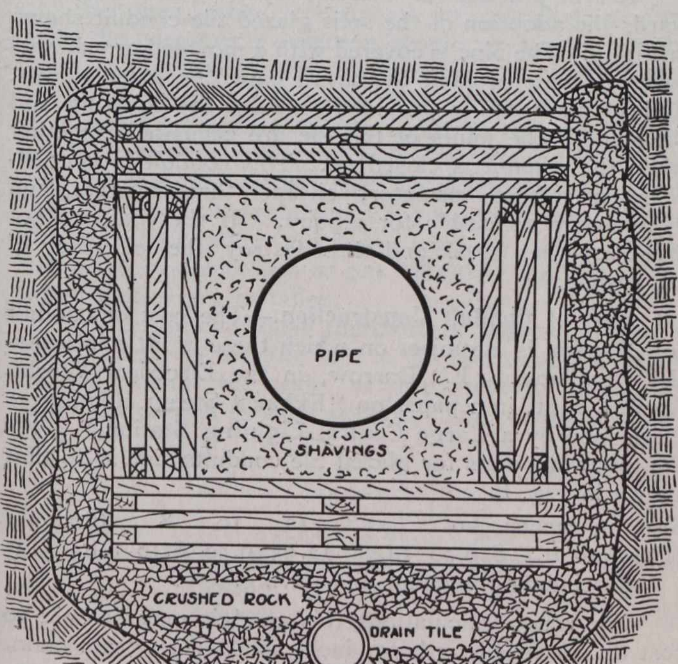

Fig. 5.—Wood Box Conduit.

The earlier heating systems were usually provided with conduits built up of boards and paper with air spaces between and filled, as a general rule, with oiled shavings, as shown in Fig. 5. These conduits were very cheap in first cost, and gave good service when new. However, in a few years the oil commenced to distill out of the shavings and the wood started to decay, especially when laid in certain soils. A very uncertain factor was the variation in decay in the length of an ordinary system due to variation in soils. Thus such systems became more inefficient with age, while the heating load, as a general rule, increased. It was also found hard to keep these conduits watertight. Their life has been stated to be anywhere from 15 to 25 years, depending on the soil surrounding them. After such experiences with this form, engineers have turned to other classes of conduit not so subject to decay or decrease in efficiency with age.

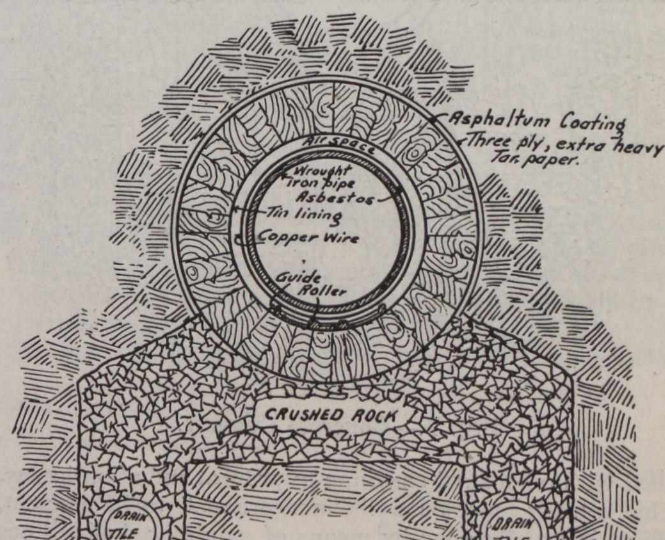

Fig. 6.—Wood Log Conduit.

An improved form of construction is shown in Fig. 6, known as the "wood-log" conduit. It consists of white pine staves which have been thoroughly air and kiln dried, cut to segmental section, and bound together into a circular form by heavy steel banding wires. These staves are provided with tongue and grooves, as shown. The outside is waterproofed by tar and usually an additional waterproof tar-paper covering is provided. The inside is lined with tin to cut down radiation losses and prevents any charring of the wood which might occur. The sections of casing can be obtained in lengths up to eight feet and are fitted together with mortise and tenon joints four inches long. The shell is usually four inches thick. The pipe is generally of wrought iron or steel, and all joints not adjacent to special fittings are made with heavy, long pattern couplings. The pipe itself is frequently wrapped with a special winding of asbestos paper secured in position by copper wire. Metal sealing rings are used at the joints of the casing when a watertight construction is desired. Girders and rollers for supporting the pipe are placed about eight feet apart. Special fittings are enclosed in watertight brick boxes

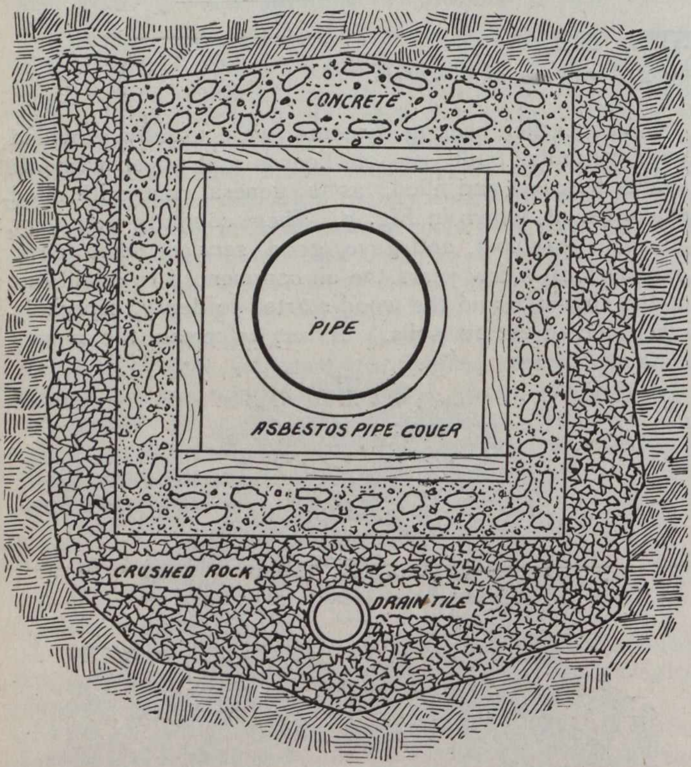

Fig. 7.—Concrete Conduit.

filled with oil-soaked shavings to prevent radiation losses. This conduit must be well underdrained to be efficient, which is usually done by means of single or double lines of 4-inch farm drain tile. It is fairly cheap and quite efficient, and can be readily taken up and repaired. The main objection to this construction is its deterioration, which is more or less rapid. In summer, when the heat is off the system, the wood is said to absorb moisture either from infiltration, from the ground, from leaky sewer pipe, or from broken water mains. The consequent swelling of the wood stretches the wires so that when hot and dried out again they are loose and allow the joints to open. The conduit is not then waterproof and the heat losses consequently increase. It has been noted in several cities that this wooden conduit deteriorates much more rapidly when laid under pavement or in cinders than when under sod.

Another form of conduit that has been used in a few cases consists of one of the wooden constructions already described, surrounded by a concrete shell.

Several heating systems have been recently built with the pipe line covered with an asbestos or similar moulded covering, which is waterproofed. A wooden box is then built around this, as shown in Fig. 7., and the whole then enclosed in a concrete box, thoroughly waterproofed and well underdrained. In some constructions oiled shavings have been used instead of the moulded covering, though less efficient. Concrete alone is not a good insulator so that dependence must be placed on the material surrounding the pipe. This conduit is expensive to lay, but is very enduring and maintains its high efficiency if it has been thoroughly waterproofed when laid. The principal objection to it is the difficulty of getting at the line for repairs or alterations.

The Milwaukee Central Heating Company use a type of conduit similar to Fig. 7, except that they install cast iron pipe with universal joints to carry the steam. This company has about 42,000 feet of main in service and have tried three different types of conduit. Their experience has led them to consider this type superior to either the wood-log construction or the concrete conduit filled with oiled shavings.

Another form of conduit, used at Beaver Dam, Wis., consists of hollow building tile in place of the concrete on the sides and top, as in Fig. 7. If this is once opened for inspection or repairs the tile is rendered useless. It has also been noted that tiles are liable to break in service, and, on the whole, this conduit has not proven very satisfactory.

Recent practice in heating systems has tended towards the adoption of the split glazed tile conduit shown in Fig. 8. The pipe is covered with a moulded or asbestos covering waterproofed by tarred paper or other means. A dead air space is provided between the covering and the tile. The joints of the tile are cemented together when the conduit is closed up. This conduit is very efficient as a heat insulator, cheaper than concrete, and more easily accessible for repairs. If the tiles are not first-class they break and thus destroy the efficiency of the system.

Cost of Conduit Construction.—The cost of conduit construction is a subject on which there is little information available. E. Darrow, in the Electrical World, April 6, 1911, in a paper on "Exhaust Steam Heating as Developed by a Large Central Lighting Station," gives the following costs for glazed tile conduits similar to that shown in Fig. 8.

Size, in inches	20	15	12	10	8	6	4
*Cost per ft.	$19.50	14.75	12.35	9.50	8.40	6.85	5.25

*Including trenching and paving.

For rough calculations this conduit may be said to cost $1 per foot length per inch diameter of steam main.

Conduits as shown in Fig. 7 are said to cost practically the same as the glazed tile. Wooden box conduits as shown in Fig. 5 are said to cost from 35 to 50% of the values given above. When hot water is used and two pipes are necessary, these costs have to be considerably increased.

There will be found in an article on "Wilkes-Barre's District Heating System," in the Engineering Record of September 14, 1912, the data reproduced in Table 4 on the costs of installing in Wilkes-Barre steam heating conduits of the type shown in Fig. 6. All re-paving was done by the city but the heating company was obliged to pay the city for permits to cut through the pavement at the rate of $3 per square yard for asphalt and $2.50 per square yard for brick, the measurements for which included an excess of 8 inches beyond the actual cut and all tunnels and cuts under the pavement.

In the table, trenching includes cutting through the pavement, excavating the trench to grade, preparing subtrenches for underdrains, all backfilling and hauling away of surplus material. Laying pipe includes the furnishing and placing of all pipe, fittings, expansion devices, wood log, etc., the furnishing and laying of underdrains and all brickwork such as boxes around special devices and manholes for valves, traps and expansion joints.

The prices given were a fair average at the time the pipe was laid, but for use at the present time should be increased about 10 per cent. This work largely replaced a former system and was installed complete between May 31 and October 23 in 1911.

Temperature Control.—One of the most essential requirements of every well operated modern heating system is the installation of some form of thermostatic control valve on all service connections. In the case of residences, this valve may be located where the service enters the house and the thermostat may be placed in a central position in the living rooms. In office buildings each radiator is usually fitted with its own control valve and thermostat.

Thermostatic control with careful handling is said to reduce the charges for service by 6 to 8 cents per sq. ft. when on a flat rate basis. When meters are used, the savings that may be effected by this control system over hand-controlled service are as much as 15 to 30%, according to several central station managers.

However, when thermostats are installed on a system, the customer's attention should always be called to the fact that unless some simple rules are strictly followed the thermostat will waste heat. For instance, a window may be opened to air the rooms in the morning, and as the thermostat maintains a constant room temperature, this window may be left open for a considerable period. This would result in an enormous waste of heat. With a flat rate the heating company loses by such practice, while the customer has to pay bills that are unduly high when meters are installed.

When air-controlled thermostatic valves are used on the system, an air line has to be laid from the central station along the side of the heating main with branches carried to each service. The compressed air in this pipe is usually at about 15 pounds pressure. Johnson, Powers or National thermostats may be used with this system. In some cases independent thermostats like the Sylphon Regithern are placed on each individual service.

Miscellaneous Central Plant Service.—Vacuum systems are now quite commonly used in large office buildings, stores, libraries, private residences, etc., for cleaning and dusting. It has long been known that one of the cheapest means of transmitting energy is by the use of compressed air. In the case of vacuum the air is much less dense than when the air is under pressure and the losses are correspondingly reduced. It has, therefore, been proposed that the central heating company might install a system of vacuum piping together with their heating system, and thus be prepared to furnish service to customers over certain periods of the day at a flat rate. No information has come to hand concerning such a

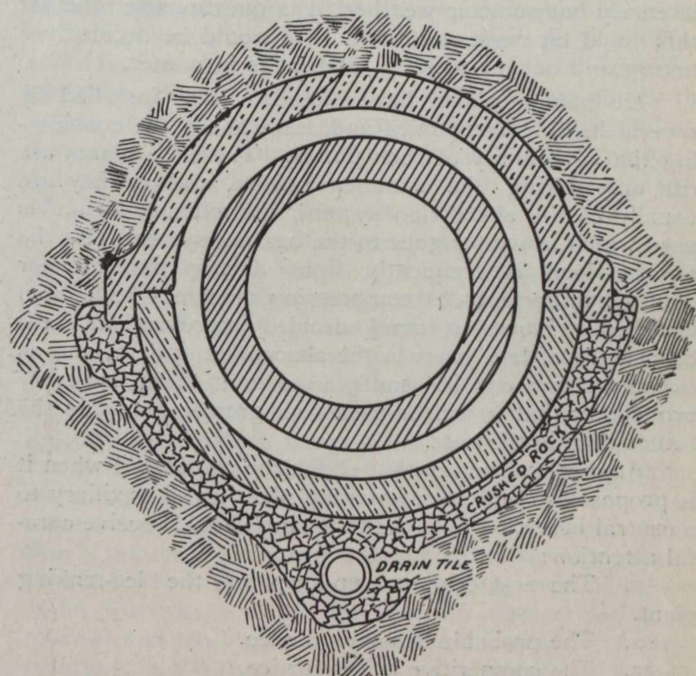

Fig. 8.—Split Glazed Tile Conduit.

Table 4.—Conduit Costs at Wilkes-Barre.

Size, in inches.	Pavement.	Length, in feet.	Re-paving. (Cost)	Trenching. (Cost)	Laying pipe. (Cost)	Incidentals. (Cost)	Total. (Cost)	Per lin. foot.
6	Brick	294	$ 405.35	$ 157.67	$ 1,210.46	.....	$ 1,773.48	$ 6.03
6	Asphalt	1,585	2,210.89	907.52	6,890.52	$ 52.04	10,060.97	6.35
8	Asphalt	489	744.68	283.95	2,878.63	3.66	3,910.92	8.01
9	Asphalt	361	533.97	229.76	2,582.40	.....	3,346.13	9.28
10	Brick	1,053	1,419.05	764.26	7,477.58	17.46	9,678.35	9.19
10	Asphalt	851	1,238.83	625.77	6,090.82	11.67	7,967.09	9.36
12	Asphalt	585	966.10	489.27	5,406.86	11.08	6,873.31	11.75
14	Asphalt	2,109	3,337.30	1,571.11	20,951.42	142.81	26,002.64	12.33
16	Asphalt	2,607	4,378.34	2,240.64	35,832.42	157.92	42,609.32	16.35
20	Brick	552	1,033.17	652.61	10,954.77	.....	12,640.55	22.89
24	Brick	275	521.83	484.18	6,807.59	6.23	7,819.83	28.39
18 and 24	Brick (in station)	....	....	......	....	.....	978.45	.....
Total	....	10,761	$16,789.51	$8,406.74	$108,061.92	$402.87	$133,661.04	
					Reconnecting house services ...		3,067.27	
					Engineering, 1.17%		1,600.64	
					Total cost of work		$138,328.95	

service at present in operation, though large hotels use these systems. However, the possibilities of such a system warrant a careful investigation of the project.

It has also been suggested that a hot water system might be supplied with cold water to cool the buildings during the intensely hot summer weather. Such results could be obtained by simply pumping cold water through the system if it were available or a system of refrigeration could be installed to artificially maintain the desired temperature. Such cooling service has been provided in some first-class hotels and in some theatres that run during the summer. Usually, however, the cooling of buildings is secured by passing the ventilating air through cold water sprays. While such cold water service as has been suggested would be welcomed by most people during the intensely hot summer weather, it is questionable whether this could be made profitable. It would be decidedly a luxury and not a necessity, as heat is in winter.

Ice-making plants have already been installed by several heating companies and many more are considering the advisability of such plants. These ice plants are run only during the summer season, and as they are usually of the absorption system, the exhaust steam is used which in winter goes to the heating system. As the electric load is frequently light during the summer months, in some cases compression machines have been installed. However, many decided improvements have been made of late years in the absorption system, and as exhaust steam can be readily used in it there is every probability that it will be used to a greater extent in the future than in the past.

Among the factors that should be considered when it is proposed to add an ice-making plant as an auxiliary to a central heating plant, the following should receive careful attention:—

1. The first cost and up-keep of the ice-making plant.
2. The probable demands for ice.
3. The competitive prices for ice.
4. The cost of making and delivering ice.
5. The power or exhaust steam available during the summer months for ice-making purposes.

A conservative estimate of the net profits to be derived from such an auxiliary plant is the real index that will show whether or not such installation is warranted.

Measuring and Charging for Central Station Service.—When central heating systems were first installed, charges for service were made by one of the following methods. At first, a fixed amount was charged the customer for the heating season equal to his average coal bill. This was unfair to the heating company, for it did not take into consideration the rising price of anthracite coal, the expense of removing ashes or the cleaning, repair and up-keep costs on the furnace used by the customer. This form of contract also encouraged the customer to minimize his former costs of coal. Besides this, customers usually practised strict economy in the use of heat from their own plants, but when this was supplied by a central station they were apt to be very wasteful. This last condition invariably occurs whenever charges are made on flat rates, and forms one of the strongest arguments against such systems of charging. A second system, which is still in use to a limited extent, provided for a fixed charge per unit of space heated. This method was often unjust, owing to the variation in the construction of the buildings heated, the height of ceilings, and use made of the building. A third method, which is still in use, consisted of a fixed charge per sq. ft. of radiation served. This system is not fundamentally correct, as it does not take into consideration the variation of heat demand with differences of glass and wall exposures, size of room, etc. However, if the radiators have been carefully designed for each room, the rates are, on the whole, very equitable. Such service should in every case be provided with thermostatic control, or otherwise the heat waste will be very great. While this method is still used to some extent with exhaust steam, it is used almost universally on hot water systems, for up to the present time no device has been placed on the market which will measure the heat supplied in hot water service. Such a meter is now being developed by Gebruder Sulzer at Winterthur, Switzerland, but has not yet been put on the American market. Some form of measured service is the best solution of the question of charges, both for the customer and for the company supplying heat.

The amount of heat supplied to a customer when exhaust steam is used can be determined by catching the condensation in a trap and discharging it through a hot water meter. The two meters of this type generally used are the "Simplex," made by the American District Steam Company, of Lockport, N.Y., and the "Detroit," made by the Central Station Steam Company, of Detroit, Mich. Other condensation meters of various types have been used and are being tried on heating systems with various degrees of success. All such instruments must be inspected periodically to see that bearings are not gummed up and stuck, that the dials are recording properly, that the spouts and nozzle are not choked up, and that the meter has not become out of level.

In some cases it is found desirable to measure the amount of steam supplied to a heating system, or, in the case of a large consumer, to measure the steam supply rather than the condensation. This can be done quite accurately by a steam flow meter. At the present time the type most widely used is that of the General Electric Company, Schenectady, N.Y. This meter is essentially a Pitot tube with either a mercury manometer or dial indicator or a special tilting device with a recording mechanism. Several tests have shown that these meters possess a high degree of accuracy for ordinary commercial work. Other steam flow meters that have been used include the Gebhardt, the St. John and the Sargent.

Water, either for boiler feed or for heating service, is most conveniently measured by the well-known Venturi meter, manufactured by the Builders Iron Foundry Company, of Providence, R.I. It is always provided with both an indicating dial and a recording dial of the circular chart type, and has an accuracy of within 2%. The Lea Water Flow Recorder, recently introduced into this country by the Yarnall-Waring Company, Philadelphia, Pa., is also used to measure and record the flow of fluids. In it the water passes over a V-notch and the quantity passing is recorded by means of a float and rack and pinion mechanism operating a pen on a paper chart driven by a clock. This apparatus cannot be used under pressure.

It will be noted that all condensation meters discharge to the sewer. This results in a certain loss of heat. When the supply of boiler feed water is bad, this loss of condensed steam is a serious matter and must be taken into consideration.

Probably the most important factor in the executive administration is the determination of equitable rates for service rendered. Rates, as already pointed out, should be based on the manufacturing cost of heat alone, independent of the financial benefits the company may derive from the use of the steam generated to develop electric power. With such rates, reasonable profits will be assured irrespective of whether live or exhaust steam is used.

The rates to be charged for service will be dependent on: (1) the cost of coal; (2) the first cost and operating cost of the distribution system, and (3) the extent of the service and the number of customers. The rates in effect in cities throughout this country are very variable, as shown by the data presented in the "Report of the Committee on Rates" at the National District Heating Association's meeting in Detroit in June, 1912. From this report it can be seen that the average season on which heat is maintained on the distribution systems is 8.5 months. About 60% of the steam used in low pressure heating systems is exhaust steam, the remainder coming direct from the boilers through reducing valves. In almost every system reported the meters, where used, were installed by the operating company, though the taps were usually supplied by the consumer. The condensation is returned to the central station in about 20% of the plants. On steam systems customers are, almost without exception, required to install economizer coils at their own expense. About 50% of the companies charge the customer for service connections. The cost of coal ranged from $1 per ton to $8 per ton. The flat rates for low pressure steam ranged from 18 cents to $1 per sq. ft. per season. The flat rates, based on cubical contents, ranged from $2.50 to $8 per 1,000 cu. ft. per season. In meter rates there was an almost infinite variety from which no general conclusions of value can be drawn. In many hot water heating systems the rate per sq. ft. is limited by ordinance. The charges for hot water services on flat rates ranged from 10 to 30 cents per sq. ft., the average charge being about 20 cents per sq. ft.

DUNMORE IS RAILWAY TERMINUS.

Dunmore, Alta, is the eastern terminus of the Crow's Nest Railway. Starting at Dunmore, the Crow's Nest line opens up Southern Alberta country, and is the main thoroughfare to the rich Kootenay district, whose development in metals, timber and fruit is in its infancy.

Traffic increased to such an extent along this railway that the Canadian Pacific Railway decided to establish a station, round-house, and extensive yards at Dunmore, and the Canadian Pacific Railway estimates for 1913 show additional trackage and shipping facilities.

Dunmore is situated in easy access to raw material required for the manufacture of brick, pottery, tile, and terra cotta work; glass factories, iron plants, cement works, etc.

Mr. C. R. Ross of the Dunmore Development Company, Medicine Hat, will supply manufacturers interested with any information.

In his oxy-acetylene welding of copper, which is proving successful in German works, Carl Canzler has developed a process somewhat different from iron welding. Larger torches are necessary, and a liquid welding paste is employed, with a special copper welding wire. Formation of oxide is prevented by the paste. Copper plates an inch in thickness have been welded without difficulty, and the strength of the weld —which is not affected by acid—is found to be quite equal to that of solid copper in a continuous sheet.

ACTION OF SALTS IN ALKALI AND SEA WATER ON CEMENTS.

In a recently issued bulletin of the United States Bureau of Standards, a paper is published containing results obtained from an investigation into the effect of alkali and sea water on concrete. The paper contains a good deal of experimental data which has been obtained during the past three years, and which is conclusive with respect to a number of points that have long been under discussion. The investigations were started in the structural materials testing laboratories of the Technologic branch of the United States Geological Survey, Mr. Richard L. Humphrey being in charge. They were transferred three years ago to the Bureau of Standards and the work continued by P. H. Bates, chemist, A. J. Phillips, assistant chemist, and R. J. Wig, associate engineer physicist, Bureau of Standards, under whose names the article appears. It is 157 pages in length and contains numerous illustrations, tables and diagrams. A few explanatory paragraphs, and the results which have been obtained to date, are given as follows:—

The disintegration of cement structures, when placed in contact with sea water, is a phenomenon which has attracted the attention of cement manufacturers and cement users almost from the first time that such material was used for marine construction. There are cement structures which have withstood the action of sea water for years and probably will continue to do so, yet there are structures which have failed; and it is also possible in the laboratory by artificial solutions to destroy almost completely a briquette, or cube, or cylinder made of cement mortars or concrete. The cause of this disintegration is not certain, though it is almost universally believed that it is the reaction of sulphate of magnesia of the sea water with the lime of the cement (formed during the setting) and the alumina of the aluminates of the cement, resulting in the formation of hydrated magnesia and calcium sulpho-aluminate, which crystallizes with a large number of molecules of water.

The other constituents both of the sea water and the cement are usually considered of little effect, though lately attention is being drawn to the fact that both sodium chloride and magnesium chloride rapidly attack the silicates.

Concrete structures have been made (especially in this country) which are resisting the attack of sea water to a marked degree. It is therefore not surprising that many engineers attribute the disintegration when it does occur to poor workmanship or materials, or to the abrasion of the sand or floating bodies in the water, and to the mechanical action of waves and frost action (as the disintegration usually takes place at or near the water line) rather than to any chemical reaction or crystallization due to such reaction.

It is not surprising that when cement structures were first placed in our arid regions this disintegration was not considered, though it was well known that these regions contain large quantities of magnesium sulphate, which, together with the sodium sulphate, forms the principal salts of the so-called "white alkali" in distinction from the black alkali, which is largely sodium carbonate. However, a short time after these structures were placed it was noticed that there was a softening of the mass along the water line and in due time this attracted considerable attention. It was investigated first by the Colorado State Agricultural College in the case of some disintegrated cement tile; and the Montana State Agricultural College in the case of the sewers and culverts of the city of Great Falls. These investigators, however, do not discuss the cause of the destruction other than to mention the sulpho-aluminate of lime formation, and in the case of the cement tile to mention that the silica and alumina were removed.

As the U.S. Government has been locating a large number of its irrigation projects in such regions, it was considered to be within the scope of the investigation of the Structural Materials Laboratories to make a study of this condition, which work was later consigned to the Bureau of Standards.

Scope of Investigations.—These investigations were planned for the purpose of determining the suitability and permanency of various cements in structures exposed to the chemical and mechanical action of sea water and alkali salts and, if possible, the cause of failure or disintegration of cements and concretes.

The study of the subject was begun in such a manner as to determine, if possible, just what reaction would take place when the salts, commonly present in sea water and alkaline soils, were allowed to act on cement mortars. In order that this study should be complete, information should be obtained not only as to what salts present in any solution might cause destruction, but also in what manner this destruction is being accomplished. Both chemical and physical investigations were made in the laboratory, and field tests in sea water were made. In both series of laboratory tests there have been used at various times, in addition to sea water from Atlantic City, solutions of sodium chloride, sodium sulphate, sodium carbonate, magnesium chloride, magnesium sulphate, ferrous sulphate, and also solutions in which there were present in equal parts by weight two salts as sodium chloride-sodium sulphate, sodium chloride-magnesium chloride, sodium chloride-magnesium chloride, sodium chloride-magnesium sulphate, sodium sulphate-magnesium sulphate, sodium sulphate-magnesium chloride, sodium chloride-sodium carbonate, sodium chloride-calcium chloride, sodium sulphate-sodium carbonate, magnesium chloride-magnesium sulphate. It will be noted that a solution of calcium sulphate was not used. This salt is comparatively insoluble, and a series of tests using it, even in a saturated solution, would hardly be comparable with the series in which the above were used and in which the solutions contained but 2 per cent. by weight of the anhydride salts. Moreover, when this solution contained the sulphuric anhydride radical, calcium sulphate would be formed in the cement.

With regard to field investigation, while much valuable information can be obtained from an inspection of existing concrete structures in sea water, it is practically impossible to obtain reliable and complete information after a structure is several years old as to the qualities of the materials used and the character of the workmanship in construction. The field laboratory was located at Atlantic City, N.J., as it was readily accessible and the sea water at this point was rather pure and undiluted from fresh-water streams. Atlantic City is situated about 150 miles south of New York on an island 7 miles long and from ⅛ to 1 mile in width, lying about 6 miles from the New Jersey mainland, with bays and salt marshes between. The building used as a laboratory, under which the exposure tests were made, was located on a pier 700 feet from shore, about 20 feet above mean tide with 20 feet depth of water beneath.

Concrete of varied composition was made with Portland, natural, slag, and other special sea-water cements under conditions approaching as closely as possible the various methods used in sea-water construction. Several thousand briquettes and other small test pieces were made and exposed to sea water in connection with the concrete tests for the purpose of comparing various types and brands of cements.

Conclusions.—The conclusions must be limited by the scope of this investigation and since the physical tests cover a period of exposure not exceeding 3½ years the conclusions should be considered as somewhat tentative.

1. Portland cement mortar or concrete, if porous, can be disintegrated by the mechanical forces exerted by the crystallization of almost any salt in its pores, if a sufficient amount of it is permitted to accumulate and a rapid formation of crystals is brought about by drying; and as larger crystals are formed by slow crystallization, there would be obtained the same results on a larger scale, but in greater time if slow drying were had. Porous stone, brick, and other structural materials are disintegrated in the same manner. Therefore, in alkali regions, where a concentration of salts is possible, a dense non-porous surface is essential.

2. While in the laboratory a hydraulic cement is readily decomposed if intimately exposed to the chemical action of various sulphate and chloride solutions, field inspection indicates that in service these reactions are much retarded if not entirely suspended in most cases, due probably to the carbonization of the lime of the cement near the surface or the formation of an impervious skin or protective coating by saline deposits.

3. Properly made Portland cement concrete, when totally immersed, is apparently not subject to decomposition by the chemical action of sea water.

4. While these tests indicated that Portland cement concrete exposed between tides resisted chemical decomposition as satisfactorily as the totally immersed concrete, it is felt that actual service conditions were not reproduced, and therefore further investigation is desirable.

5. It is not yet possible to state whether the resistance of cements to chemical disintegration by sea water is due to the superficial formation of an impervious skin or coating, which is subsequently assisted by the deposition of shells and moss forming a protective coating, or by the chemical reaction of the sea salts with the cement forming a more stable compound without disintegration of the concrete, or by a combination of both of these phenomena.

6. Marine construction, in so far as the concrete placed below the surface of the water is concerned, would appear to be a problem of method rather than materials, as the concrete sets and permanently hardens as satisfactorily in sea water as in fresh water or in the atmosphere, if it can be placed in the forms without undue exposure to the sea water while being deposited.

7. Natural, slag, and other special cements tested in concrete mixtures showed normal increase in strength with age both in sea water and in fresh water.

8. In the form of neat briquettes most of the Portland cements of high iron content, several of the cements of high or normal alumina content and one special slag cement did not show any marked difference in tensile strength whether exposed to fresh or sea water for all periods up to two years. Other cements of various com-

positions showed signs of disintegration after a few weeks.

9. All cements resisted disintegration in sea water better in mortar mixtures than in the form of neat briquettes. In most cases the mortar briquettes had normal strength up to 2 years' exposure.

10. The physical qualities of the cement, which depend essentially upon the method of manufacture, would seem to determine its resistance to decomposition when brought into intimate contact with the sulphate and chloride solutions.

11. Contrary to the opinion of many, there is no apparent relation between the chemical composition of a cement and the rapidity with which it reacts with sea water when brought into intimate contact.

12. Tricalcium-sulpho-aluminate could not be formed, and therefore disintegration could not result from this cause.

13. In the presence of sea water or similar sulphate—chloride solutions:

(*a*) The most soluble element of the cement is the lime. If the lime of the cement is carbonated it is practically insoluble.

(*b*) The quantity of alumina, iron, or silica present in the cement does not affect its solubility.

(*c*) The magnesia present in the cement is practically inert.

(*d*) The quantity of SO_3 present in the cement up to 1.75 per cent. does not affect its solubility, but a variation in the quantity present may affect its stability by affecting its rate of hardening.

14. The change which takes place in sea water when brought into intimate contact with the cement is as follows:

(*a*) The magnesia is precipitated from the sea water in direct proportion to the solubility of the lime of the cement.

(*b*) The sulphates are the most active constituents of the sea water and are taken up by the cement. Their action is accelerated in the presence of chlorides. No definite sulphate compound was established.

(*c*) The quantity of chlorine and sodium taken up by the cement is so small that no statement can be made as to the existence of any definite chloride of sodium compound formed with the cement.

15. The SO_3 added to a cement in the plaster to regulate the time of set is chemically fixed so that it will not go into solution when the cement is brought into intimate contact with distilled water.

16. Metal reinforcement is not subject to corrosion if embedded to a depth of 2 inches or more from the surface of well-made concrete.

An economical mine telephone system, already at work in a Prussian mine, has been brought to notice by O. Dobbelstein, a German electrical engineer. Any of the continuous lines of metal extending into the mine—such as rails, air or water pipes, or cables—may be used as a conductor, and the other side is earthed in the usual way, although the metal is already connected to earth. The usual telephone receiver is used. Current is supplied by a battery of 12 volts, and in the secondary circuit an induction coil is used. As the current is not sufficient to ring a bell, a form of relay is necessary. The telephone current energizes a weak magnet, and this vibrates a metal disc, which acts upon the special circuit to ring a bell. Temporary telephones may be quickly put in place, or the installation may be of permanent kind.

PAVEMENT SUB-GRADE.

By S. J. Van Ornum,

Consulting Engineer, San Francisco, Cal.

Engineers who have charge of road building have, as a rule, given slight attention or thought to the proper preparation of the earth sub-grade upon which pavements are constructed. It is obvious that the earth under a pavement sustains the weight of the traffic, and if the earth sub-grade is not prepared properly and compacted sufficiently to sustain such loads, irregularities and depressions will gradually appear in the pavement. The official organ of the League of California Municipalities contains an article in its July 13th issue by Mr. Van Ornum which brings up strongly the necessity of carefully constructed sub-grade and carefully prepared specifications covering the same.

The pavement base provides a stable material upon which to construct the wearing surface, and also equalizes and distributes on the earth sub-grade, the loads subjected to the pavement by the traffic.

The weight of loads hauled by wagons and trucks has increased rapidly in the past few years, and especially is this true since the automobile truck has become so successful. Loads as great as ten and twelve tons are now hauled by automobile trucks over pavements which were not constructed to properly withstand such weights. Great care should, therefore, be taken to provide a sub-grade so prepared and compacted that it will sustain the heaviest loads imposed upon the pavement without injury to the base or wearing surface. Recent reports from New York and London state that the excessive loads transported over some of the streets of these cities have caused serious injury to the concrete base. One street pavement in London, which for many years has carried a very heavy street traffic without apparent damage, shows signs of failure since automobile 'bus lines have been running over it, and an examination discloses the fact that the concrete base has badly subsided.

Although engineers realize the necessity of a properly compacted paving sub-grade, yet, in preparing specifications they give slight consideration to this phase of paving construction, with the result that the section relating to the rolling of the sub-grade is generally inadequate and often not sufficiently explicit to obtain a hard and firm sub-grade. When the engineer has implied authority, the phrase "rolled to the satisfaction of the engineer" is quite general. One paving specification recently examined simply states that the sub-grade "is to be compacted by rolling or tamping," but failed to place any conditions or restrictions upon such rolling or the weight of the roller to be used. Another specification for the construction of a standard pavement required the sub-grade "to be compacted by rolling and tamping," and the rolling "to be done by a steam roller of a weight not less than five tons." A five tandem roller has an effective compressive weight of approximately 175 pounds per lineal width of tire, while the wagons hauling the materials over the sub-grade for the paving of the street exert a pressure of over twice this amount and loads as great as one thousand pounds per lineal inch width of wheel tire are at the present time hauled over pavements.

A light roller will not sufficiently compact the earth, nor will it disclose any local weakness in the sub-grade, such as carelessly refilled pipe trenches or an improper character or condition of material immediately underneath the surface of the sub-grade, but will simply form a slight surface crust which has insufficient strength to sustain heavy loads. The writer has observed standard pavements badly subsided and shattered and their life greatly decreased due entirely to the faulty preparation of the sub-grade.

Heavy rollers are so constructed that the effective rolling is accomplished by the rear two wheels and the weight is generally distributed so that approximately one-third the weight of the roller is carried by each wheel. Specifications for compacting sub-grades in general require the use of a certain weight of roller expressed in tons, or provide a minimum weight per lineal inch width of roller tires. Road rollers are manufactured with several widths of rear wheels, and by merely specifying the weight of the roller the compression per lineal inch width of tire can vary to a considerable extent, and thus a heavy roller with wide tires will not give as much actual compression as one weighing two tons less which has narrow tires. On the other hand, a heavy roller may be specified, which with narrow tires gives an excessive weight and might endanger water and other pipes if the ground be in a loose and unstable condition. The minimum and, in unfavorable soil conditions, the maximum compressive weight per lineal inch width of tire seems the more logical manner of specifying the weights, and obviates any uncertainty of the compression which will actually be used in rolling the sub-grade.

The slight increase of cost which thorough rolling entails is incomparable with the added durability and utility of the completed pavement resulting from a well compacted and solid sub-grade.

ELECTRIFICATION OF RAILWAYS.

In connection with the consideration which the Canadian Pacific Railway Company is giving to the electrification of a portion of its lines, it is interesting to note what American railways are doing in this respect. The day of electrification of steam roads is dawning. It has been stated that it costs about the same, mile for mile, to electrify as to build a new road, and the question is, therefore, almost entirely one of the advisability of heavy investment.

The Pennsylvania Railway is contemplating electrifying its line between Pittsburg and New York, a distance of over 400 miles, which will be at least double-track, and which will cost approximately $40,000 per single track mile.

In the Western States the Great Northern Railway, and the Chicago, Milwaukee and Puget Sound Railway have planned the electrification of 530 and 440 miles respectively, contracts having already been let for roadbed, power, etc. This revolutionary step is occasioned by the poor coal and water conditions with which steam locomotives have to contend in North Dakota, Montana and Idaho, and with hydro-electric power in abundance.

The Denver, Rio Grande and Western is electrifying one of its mountain divisions, 114 miles in length. Some 73 miles of mountain electrification for heavy coal haulage is a very interesting application of electricity in railroading which the Norfolk and Western Railway is planning in West Virginia. The new suburban electrified section of the Pennsylvania, extending from Philadelphia to Paoli, will comprise 70 miles of single track.

Electrifications which have already been made in the United States by steam railroads are as follows:—

Railway	Miles of single track.
Baltimore and Ohio — The original electrification of the steam railroad. The pioneer user of heavy electric locomotives.	7.4
New York, New Haven and Hartford — Including 22 miles on the Hoosac tunnel route of the Boston and Maine, the lines from New York to Stamford, and Providence to Warren (38.5 miles and 109.3 miles); the Harlem River Branch, 141.4 miles; the line from Stamford to New Haven, now nearing completion, 210 miles, besides more than 50 miles of short lines, including a very complete system about Hartford.	594.8
New York Central — Two hundred and thirty-four miles out of New York City, 19 miles on the Michigan Central (Detroit River tunnel), and 118 miles on the West Shore Railroad between Utica and Syracuse.	371.6
Pennsylvania — Comprising 186.8 miles on the Long Island Railroad, 98.4 miles on the Pennsylvania's approach into New York, and 150.3 miles between Camden and Philadelphia.	435.5
Butte, Anaconda and Pacific — An ore-carrying mountain line	90.0
Southern Pacific — Suburban lines at Berkeley, Oakland and Alameda, Cal., close to San Francisco Bay.	96.0
Grand Trunk — Four miles of tunnel track (St. Clair tunnel) at Port Huron, Mich.	4.0
Erie — In Central New York to the south of Rochester.	40.0
Great Northern — The electrification of the Great Northern Railway's cascade tunnel, between Leavenworth and Skykomish, about 100 miles east of Seattle.	6.0

Word comes from London that Dr. Goldschmidt, the inventor of a new system of wireless telegraph which, it is said, will revolutionize such communication, has telegraphed his London agent that he has satisfactorily established communication between Neustadt, Ruebenberg, near Hanover, Germany, and Tuckerton, N.J., for two days during the day time, when the power employed at Neustadt—namely, 150 kilowatts, was more than sufficient for the distance of 3,900 miles. In the tests the new "singing wheel" used in this invention showed itself to be capable of such delicate adjustment that secret messages can be sent inasmuch as it can be varied and adjusted instantaneously to any length of wave. The reception of messages is so delicate that an attempt to tap it would involve the necessity of another company tuning to within .0 per cent. of a Goldschmidt message in order to be able to receive anything that could be understood. An English company with a privately-subscribed capital of $5,000,000 will probably be registered shortly. Sir Oliver Lodge, the scientist, expresses the opinion that the Goldschmidt machine will rule the aerography of the future.

PUBLIC CONSTRUCTION CONTRACTS.

The special committee of the American Society of Engineering Contractors presented a report which contains a fund of suggestions concerning public construction contracts. The report, which was made by Mr. Wm. B. King, is not an exhaustive one, but serves well as a basis for further discussion among engineers and contractors. As appearing in the Journal of the society for March, it contains the following:—

1. Your committee thinks it impossible to submit a complete form to cover all phases of all engineering contracts, but a work of much value can be done by adopting some general principles and formulating them so that they may be made a part of substantially every contract.

2. Every condition of whatsoever character by which the parties are to be bound should be submitted to bidders as a part of the specifications on which they bid. The contract to be signed should be annexed to the specifications. In this way the bidder is not liable to be surprised by new conditions appearing in the contract submitted for his signature after his bid is made and accepted.

3. The greatest vice of contracts is uncertainty. In adopting any form of contract or specifications, every effort should be made to secure exactness of definition of the rights and duties of both parties.

4. Recognizing the impossibility of foreseeing every emergency, some authority must be devised for the determination of either unexpected physical conditions or unforeseen ambiguities in the contract.

5. The first requisite to this is promptness, so that work may proceed. This doubtless requires that all disputed questions shall be primarily settled by the engineer present on the work.

6. But, while the engineer is the best fitted person to reach a prompt decision, his relation to the owner unfits him for an impartial decision. There must, therefore, be some provision for an appeal to an impartial tribunal, and final settlement of all disputes by it.

7. Disputes should, as far as possible, be settled as the contract progresses, so that the parties can know how they stand. To this end, all matters of dispute should be reduced promptly to writing and all appeals from the engineer's decisions should be promptly taken.

8. Each party should assume full responsibility for his own share of the contract.

9. This involves the assumption by the owner of responsibility for the local conditions and for the borings or other explorations of the site. The contractor should bid on guaranteed local conditions, with an increase or reduction of price for variations from these. The locality belongs to the owner and the contractor should not be obliged to gamble on it.

10. The principle also requires that a contract should not both provide the exact details of construction and guarantee the result. If the contractor is to do the work according to exact plans furnished him by the owner, the owner should take the responsibility for the result. If the contractor guarantees the result, he should be free to adopt his own methods of construction.

11. The contractor, especially when bound by a time limit, should be given the utmost freedom as to the order and manner of doing the prescribed work.

12. Definite provision should be made for the assertion in writing of demands made by either party varying from the normal contract price. The contractor should give prompt notice of a claim for extras and the owner of a claim for a decrease or for the assessment of damages.

13. Some rule should be prescribed for the owner's protection in case of delay on the contractor's part, either by a right to annul the contract, or to take over the work in whole or in part, or to deduct actual or liquidated damages. The subject is one of great difficulty and needs most careful consideration.

14. The contractor should be protected from loss by delay of the owner or the owner's other contractors and provision made for settling such losses, without suit, where possible.

15. What is the proper amount of retained percentages? What should be the maximum part of the contract price to be retained until final payment? Differences of opinion should be adjusted and a uniform rule adopted.

16. Material men insist that the contract bond should provide for payment for materials and labor. This leads to greater security to the material men and consequently lower prices. But it is an unnecessary cost to contractors to establish credit. This subject needs the views of both sides.

17. Some contractors and engineers maintain that the contract conditions should be as brief as possible. Your committee believes that all subjects which experience has shown may produce conflict should be definitely disposed of by the provisions fixed in the contract, even if this extends its length.

18. After every effort has been made to avoid all uncertainty in the contract and to settle disputes as they arise, some honest differences of opinion as to the rights of the parties may persist to the end of the contract. The final settlement of uncontested matters should be made without prejudice to the right of the contractor to recover disputed claims in the courts. It has, unfortunately, become too common to declare that on final payment the contractor shall sign a release of all claims arising out of the contract. This is a one-sided and dishonest provision. When payment is earned by a fulfilment of the contract, it ought not to be denied because the contractor believes that he is entitled to more, nor should he be forced by necessity to waive access to the courts to correct wrongs done him in the course of the contract.

Your committee might extend this discussion much farther, but believes that enough has been said to show the difficulties of the subject and the need of full consideration. Many forms of contracts have been drawn by various authorities. The standard forms of the Royal Institute of British Architects and of the American Institute of Architects have much to commend them. One general remark may be made in regard to nearly all such forms—that they have been generally prepared by persons representing owners, such as architects and engineers, and that, however fair their intention, the inevitable tendency has been to protect the owner's rights at the cost of the contractor's.

Boiling an iron or steel article in a gallon of water to which has been added four ounces of phosphoric acid and an ounce of iron filings will give it a black, non-corroding coating.

Canada's waterpower is estimated at 16,600,000 horsepower, equal to an annual production of 367,000,000 tons of coal; only 1,016,521 horse-power has been developed.

THE DESIGN OF A REINFORCED CONCRETE ABUTMENT.

Application of Theoretical Formulæ to Practical Design.

By H. R. Mackenzie, B.A.Sc.

The general dimensions for the abutment shown in detail in Fig. 1, as designed for general use, are from the set of standard abutments of the Board of Highway Commissioners for the Province of Saskatchewan. The distance from bottom of footing to grade level is taken as 24 feet. The spans allowed for are truss spans up to and including 175 feet. The bottom chords of the standard Petit truss bridges are 17 feet 6 inches centre to centre. The width and depth of bridge seat are constant and the wing wall of the abutments slope back at an angle of 30 degrees with the face wall and decrease in height at a 1½ to 1 slope.

The dead load for a 175-foot Petit truss span consists of steel, 1,250 lbs. per lineal foot, while the live load is assumed as 100 lbs. per square foot of floor, (16 feet wide), and a 25-ton traction engine, with two-thirds of its weight assumed to act on rear wheels, which are 30 inches wide and 8 feet centres; axles being 10 feet centres.

This abutment was designed by the aid of general usages and empirical formulæ, and it is the purpose of this article to investigate the design from the standpoint of theoretical formulæ.

Foundations.—When rock foundations are unattainable on account of the great depth of soil, piles are driven to increase the bearing capacity of the foundations. If the nature of the soil is accurately known, the number of piles required can usually be determined before the excavations are made. As a guide in determining the necessary increase in bearing capacity of a certain soil, or the allowable stress on foundations of other materials, Baker's and Rankine's tables of crushing strengths for various materials likely to be used as foundation beds for abutments are of great service.

It is the custom of the Board of Highway Commissioners for the Province of Saskatchewan to carry the excavation to such a depth that the top of the piles shall be below low-water level. This condition is not required in the case of concrete piles, but the equipment required in driving is more elaborate, and is usually not included in the plant of contractors doing this class of work, hence wooden piles of 25 feet in length with a minimum diameter at the tip of 6 inches, are always used under normal conditions. These piles are placed principally under the main buttresses, centre of wing walls, and toe of footings, and vary from three feet to five feet centres, according to the requirements of the specific case considered. Spacing is left largely to the judgment of the resident engineer.

Design.—The base is approximately one-half the height. Two buttresses support the bridge seat, and are placed directly beneath the centres of bearing of the bottom chords of the truss. A face wall connects these buttresses, which resists the lateral earth pressures transmitted through the earth. The face wall is continued forming the wing walls. The buttresses and the face wall rest on a continuous base which resists the earth pressures. At the back of the bridge seat is a parapet wall supported by the bridge seat, which runs into the wing walls and simply serves as a retaining wall to protect the bridge seat.

Parapet Wall.—This wall is designed as a cantilever beam connected by continuous reinforcement to the bridge seat. Its height is 2 feet 6 inches. We shall consider a strip one foot wide, assuming that the line of cleavage of material behind the wall is at a slope of 30 degrees to the horizontal, or that ϕ equals 30 degrees. Hence Rankine's formula for resultant earth pressure becomes,

$$P = \frac{w.\ h.^2}{6}, \text{ where } h = 2.5, \text{ and } w = 100 \text{ lbs.; and}$$

therefore, P = 104 lbs.

For live load pressure we will assume the worst possible case of loading, i.e., when rear wheels of 25-ton traction engine are just off the bridge. This live load of 33,000 lbs. we shall assume to be distributed on 6 linear feet of roadway. Therefore, the load per lin. foot of

$$\text{roadway equals } \frac{33{,}000}{6} \text{ equals } 5{,}500 \text{ lbs.}$$

This live load of 5,500 lbs. per lin. foot of roadway is assumed to be distributed over a distance equal to the out to out dimension of the rear wheels which is 10.5 feet, therefore, the vertical pressure due to live load equals

$$\frac{5{,}500}{10.5} \text{ equals } 525 \text{ lbs. per square foot.}$$

$$\text{Horizontal pressure equals } \frac{525}{3} \text{ equals } 175 \text{ lbs. per}$$

square foot. Bending moment of resultant earth pressure assumed to act at lower third equals

$$w.\ l. = 104 \times 10 = 1{,}040 \text{ in. pds.}$$

Bending moment of uniformly distributed live load of 175 lbs. per square inch equals

$$\frac{w.\ l.}{2} = \frac{175 \times 2.5 \times 30}{2} = 6{,}575 \text{ in. pds.}$$

Total moment = 1,040 + 6,575 = 7,615 in. pds.
Hence, from theory of beam, 108 b. d.² = 7,615; and d = 2.4 inches.

In order to secure against impact, and to protect the steel, this beam is made 6 inches thick.

Amount of steel required = 12 × 2.4 × .008 = .22 square inches per foot of wall. Use ¾-in. rods, (area = .44 sq. ins.) spaced 2 feet centre to centre. Also to resist cross bending, horizontal rods ¾-in. diameter and 15-in. centres are used.

Face Wall.—The face wall is designed as a horizontal beam supported by the buttresses. As buttresses are 17 ft. 6 in. centres, and assumed 4 feet wide, we have a clear span of 13 ft. 6 in. Consider a strip one foot wide at base of face wall, assuming the thickness of footing to be 1 ft. 6 in., the depth of fill at centre of strip equals

$$22 \text{ feet. Hence, } p = \frac{w.\ h.}{3} = \frac{100 \times 22}{3} = 733 \text{ lbs per}$$

square foot.

The live load stresses are assumed to have become dissipated in the embankment before reaching this depth. Hence bending moment equals

$$\frac{w.\ l.}{10} = \frac{(733 \times 13.5) \times (13.5 \times 12)}{10} = 160{,}000 \text{ in. pds.}$$

Therefore, 108 b. d.² = 160,000, from which d = 11.2 ins. Similarly we shall examine a strip one foot wide at depth

$$\text{of 15 feet. } p = \frac{w.\ h.}{3} = \frac{100 \times 15}{3} = 500 \text{ lbs. per sq. ft.}$$

Bending moment equals

$$\frac{(500 \times 13.5) \times (13.5 \times 12)}{10} = 109{,}500 \text{ in. pds.}$$

Therefore, $108 \text{ b. d.}^2 = 109{,}500$ and $d = 9.2$ ins.

Area of metal required at this point, $9.2 \times 12 \times .008 = .88$ square inches.

amount required to make the beam equally strong in tension and compression. The vertical reinforcement consists of ½-inch round bars at 12-inch centres.

Bridge Seat.—The buttresses are designed to carry the bridge loads directly to the base, hence the bridge seat has no direct load to carry; but it carries a portion of the overturning moment from the parapet wall and

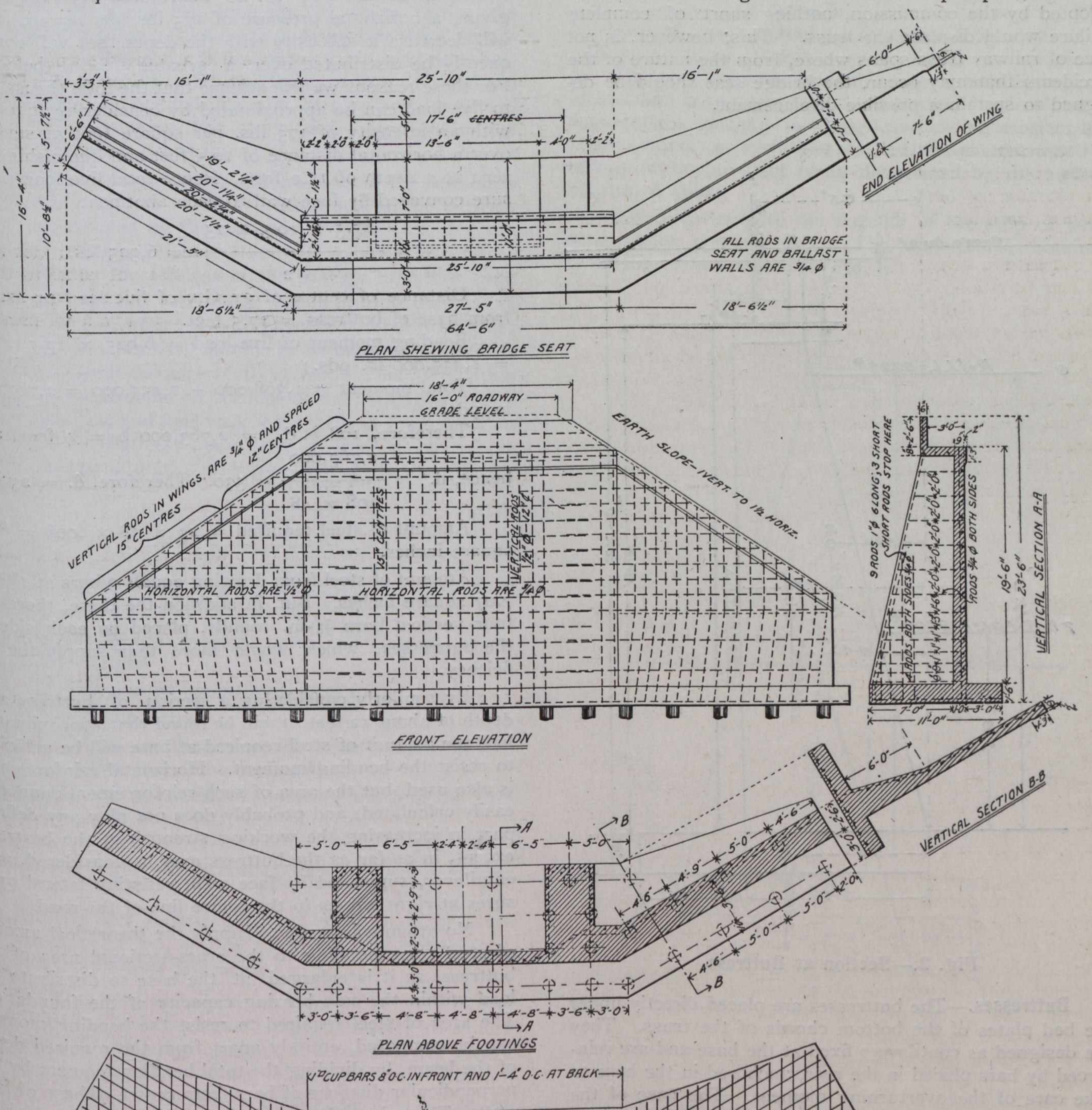

Fig. 1.—Standard Reinforced Concrete Abutment; Board of Highway Commissioners, Saskatchewan.

To ensure against impact and transmitted live load pressures, the face wall is made 9 inches deep at the top, tapering to 12 inches at base. The amount of reinforcement shown in drawing is much less than the theoretical

also acts as a bond between the buttresses, thus adding to the stability of the structure as a whole. The depth of 8 inches employed is amply sufficient for these purposes. The vertical bars in parapet wall are bent and continued across bridge seat, while the longitudinal reinforcement consists of ¾-inch round bars 12-inch centres.

Bridge seats are sometimes designed to carry the load of the girder to the buttress if the girder should be accidentally displaced. This is thought by the writer to be an unnecessary precaution, as when the bearings of the truss are anchored to the buttresses in the usual manner adopted by the commission, nothing short of complete failure would displace the truss. This, however, is not true of railway truss spans where, from the nature of the accidents that may occur, the bridge seat should be designed to sustain a possible displacement.

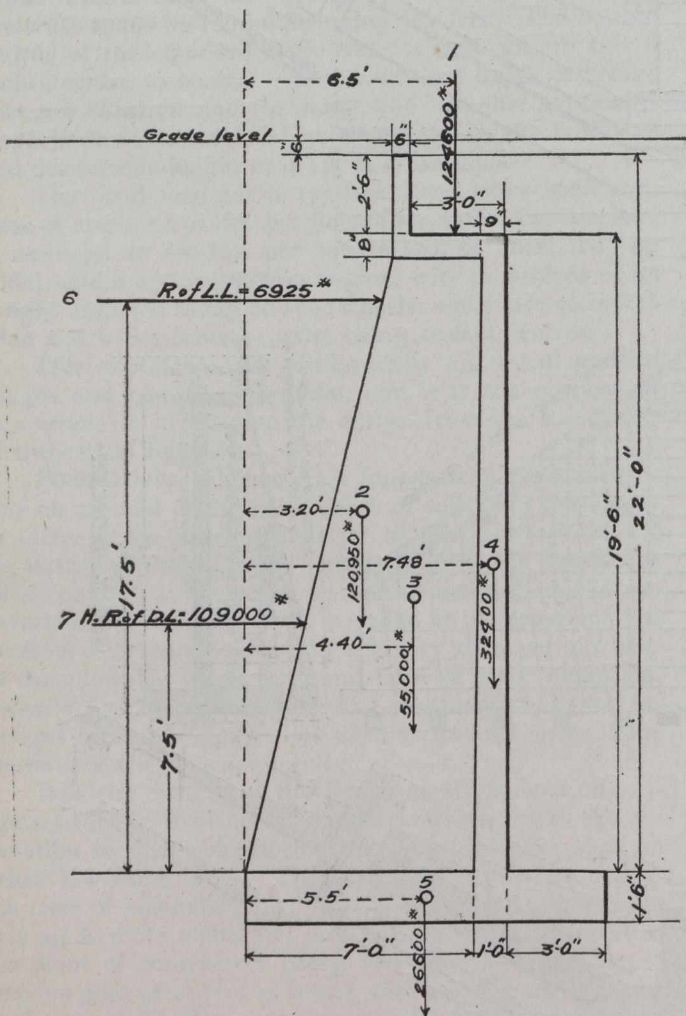

Fig. 2.—Section at Buttress.

Buttresses.—The buttresses are placed directly under the bed plates of the bottom chords of the truss. They are designed as cantilevers fixed at the base and are reinforced by bars placed in the rear, anchored in the base to take care of the overturning moment. The base of the buttress is large to secure the distribution of the abutment reaction over a considerable area of the footing.

Consider the required depth of buttress at the base: Depth to base of buttress = 22.5 ft. Therefore, resultant horizontal pressure on one foot of wall equals

$$\frac{w.h.^2}{6} = \frac{100 \times (22.5)^2}{6} = 8,437 \text{ lbs.}$$

Total width between wing walls equals 25 feet 10 inches.

Therefore, $\frac{25' \ 10''}{2}$ = 12.9 feet of wall supported by each buttress.

Therefore, the resultant dead load pressure on each buttress equals 8,437 × 12.9 = 109,000 lbs.

The bending moment of this resultant acting on an arm equal to one-third of the height equals 109,000 × 7.5 × 12 = 1,308,000 in. pds.

The live load of 5,500 lbs. per lin. foot of road, which, when assumed to be distributed over 10.5 feet giving a horizontal pressure of 175 lbs. per square foot, will decrease in intensity with the depth, but will consequently be distributed over a greater area of the wall. For these reasons we will assume that the total thrust due to live load can be approximated by considering it to act with an intensity of 175 lbs. per square foot at surface over a horizontal distance of 10.5 feet and diminishing to zero at a depth of 15.0 feet. Hence total live load pressure conveyed by face wall to each abutment

$$= \frac{87.5 \times 10.5 \times 15}{2} = 6,925 \text{ lbs.}$$

Distance of centre of gravity of live load pressures from base of buttress = 17.5 feet.

Bending moment of live load = 6,925 × 17.5 × 12 = 1,455,000 in. pds.

Total moment = 1,308,000 + 1,455,000 = 2,763,000 in. pds.

Therefore, 108 b. d.^2 = 2,763,000 b = 4 feet, and

hence, $d.^2 = \frac{2,763,000}{108 \times 48} = 530.$ Therefore, d. = 23 ins.

Amount of steel required = 23 × 48 × .008 = 8.85 square inches.

Amount of steel from drawing equals 9 bars at 1"Φ = 7.07 square inches. But, in addition the these, there are four vertical bars ¾-in. rounds, placed on each side of the buttresses, which would more than supply the deficiency.

By similarly considering a section of buttress at a depth of about 12 feet, it will be found that approximately half the amount of steel required at base will be sufficient to resist the bending moment. Horizontal reinforcement is also used, but the area of such reinforcement cannot be easily calculated, and probably does not play any definite part in increasing the working strength of the buttress, except, in as far as the buttress may be considered, as a cantilever, supported by face wall, resisting lateral pressures at right angles to the centre line of the road.

No attempt is made to supply the theoretical amount of steel corresponding to the cross-sectional area of the buttress, as it is enlarged at the base to distribute the load within the safe bearing capacity of the foundation. The area of steel required to resist the bending moment can be computed, entirely apart from the required depth of the beam, by dividing the total bending moment by the perpendicular distance of bars from centre of base of face wall. This gives the required tensile strength which, if divided by the working stress per square inch of metal, will give the required area in square inches.

We shall now investigate the stability of the abutment at a section through one of the buttresses. Fig. 2 shows the dimensions at such a section as well as the position and intensity of the various forces due to live load and dead load stresses which act either directly on the buttress or are transferred to it by the base and face wall.

Force (1) = Abutment reaction of truss.

Force (2) = Weight of earth fill resting on buttress and projection of base pertaining to buttress.

Force (3) = Weight of buttress.
Force (4) = Weight of face wall, bridge seat and parapet wall pertaining to buttress.
Force (5) = Weight of base pertaining to buttress.
Force (6) = Resultant of live load pressures.
Force (7) = Resultant lateral earth pressures.

In calculating the intensity of these forces the weights of a cubic foot of earth and concrete were assumed to be 100 lbs. and 150 lbs. respectively, and each buttress is assumed to carry the forces acting on, and the dead weight of, one-half the area of base and face wall, etc., included within the out to out dimensions of the buttress, namely, 10.75 lin. feet.

The relative positions, and intensity of the resultants of the horizonal and vertical forces acting on the buttress were determined by the method of moments, and are shown in Fig. 3. The resultant "R" of these two forces was found by the solution of the triangle of forces, and equals 376,250 lbs. Its line of action cutting the base at a point 2.8 feet from toe. The resultant vertical pressure of 359,550 lbs. we shall assume to be uniformly distributed over a lineal distance of 10.75 feet. This assumption is considered rational on account of the binding action of the bridge seat and face wall being such as to allow of no movement of buttress apart from a displacement of the abutments as a unit. Also from the application of the formula

$$\frac{\overline{p}}{p} = \frac{1}{1 + \frac{x_0\ x_1}{K^2}}$$

where $\overline{p}$ = Average pressure over rectangular cross-section

p = Maximum pressure on section

x_0 = Eccentricity

x_1 = Half the dimension of cross-section in the direction of the eccentricity,

we can assume the effective supporting width of the base to be 2.8 × 3 = 8.4 feet.

$$\text{Therefore, } \overline{p} = \text{the average pressure} = \frac{359{,}550}{10.75 \times 8.4}$$

= 3,970 lbs. per square foot, and hence, p = pressure at the toe, = 3,970 × 2 = 7,940 lbs. per square foot, since the eccentricity is assumed to be 1/6 b.

The safe load per pile being assumed as 30 tons, and as area attributed to each pile is approximately 10 square feet, we have a bearing capacity of 6,000 lbs. per square foot due to piling alone. Also, as a conservative estimate we can assume the bearing capacity of the soil under ordinary conditions to be 25 lbs. per square inch, equal to 3,600 lbs. per square foot. Hence, total bearing power of foundation equals 6,000 × 3,600 = 9,600 lbs. per square foot. Therefore, the pressure at the toe of base is not beyond the resisting power of the foundation.

Wing Walls.—The wing walls are designed as cantilevers anchored at the base. Consider a strip of wall one foot wide, where height above footing is 15 feet. As wall is surcharged with material at natural slope the resultant earth pressure, $P = \frac{1}{2}\ w.\ h.^2 \cos.^2 \phi = \frac{1}{2}.\ 100.\ (15)^2\ (.886)^2 = 8{,}450$ lbs.

No live load is considered at wing walls, hence total moment at base of wall = 8,450 × (5 × 12) = 507,000 in. pds.

Therefore, $108\ b.\ d.^2 = 507{,}000$

$$d.^2 = \frac{507{,}000}{108 \times 12} = 392$$

$$d. = 20 \text{ in.}$$

Area of steel required per foot of wall = 20 × 12 × .008 = 1.9 square inches.

The area of metal from drawing is only .44 square inches, and is constant from base to top of wall. This is apparently a mistake in design as bending moment decreases rapidly as surface is reached, the amount required at any particular point being determined by the method illustrated above.

Let us investigate the stability of the strip of wing wall under consideration. The dimensions, obtained from Fig. 1, are shown in Fig. 4.

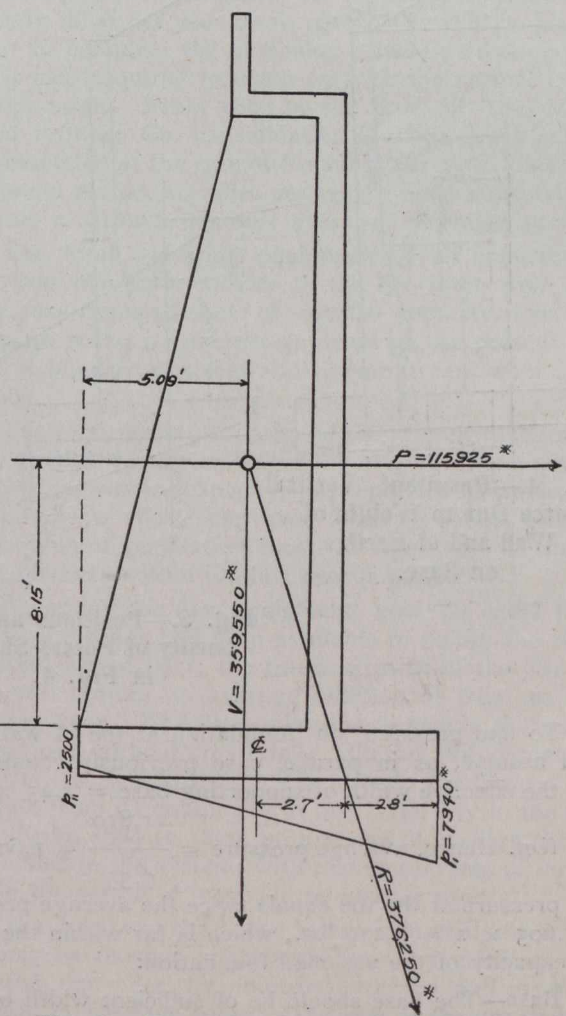

Fig. 3.—Resultant Forces at Buttress.

To find the resultant vertical force due to weight of wall and of area of earth resting on rear projection of base, we divide the wall into two parts, as shown, determining the weight and position of centre of gravity of each, also determining the weight of earth supported and its centre of gravity. The results obtained are shown in Fig. 4, and are based on the previous assumption that a cubic foot of earth and concrete weigh respectively 100 and 150 lbs. In order to find the position of the resultant of the three forces (1), (2) and (3), take moments about a vertical line through the heel.

$$\text{Moment of force (1)} = 8{,}320 \times 2.33 = 19{,}400$$
$$\text{Moment of force (2)} = 1{,}120 \times 5.57 = 6{,}250$$
$$\text{Moment of force (3)} = 2{,}370 \times 4.65 = 11{,}000$$

$$\Sigma x = 11{,}810 \qquad \Sigma m = 36{,}650$$

$$y = \frac{\Sigma m}{\Sigma x} = \frac{36{,}650}{11{,}810} = 3.10 \text{ feet,}$$

equal distance of resultant vertical force from axis of moments.

The position and intensity of the two forces affecting the stability of the wall are shown in Fig. 5. The resultant, "R," is found by solution of the triangle of forces equal to 17,500 lbs., and cuts the base 2.45 feet from the toe.

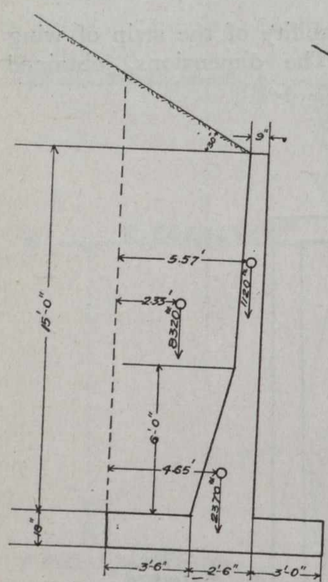

Fig. 4.—Resultant Vertical Force Due to Weight of Wall and of Earth on Base.

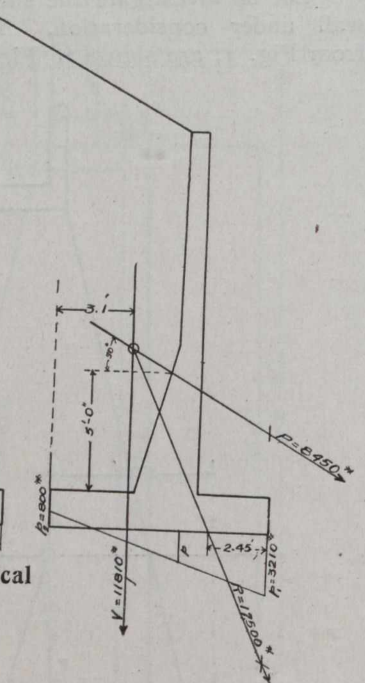

Fig. 5.—Positions and Intensity of Forces Shown in Fig. 4.

To find pressure on foundation at toe of wall, we shall assume, as in parallel case previously considered, that the effective width of supporting base = 2.45 × 3 = 7.35 feet. Hence, average pressure $= \frac{11{,}810}{7.35} = 1{,}605$ lbs.

The pressure at the toe equals twice the average pressure = 1,605 × 2 = 3,210 lbs., which is far within the bearing capacity of the assumed foundation.

Base—The base should be of sufficient width to properly distribute the load within the safe bearing capacity of the foundation. At the buttresses or any intermediate point the three-foot projection beyond face wall is subjected to an average upward soil pressure of 6,520 lbs. per square foot. This projection is assumed to act as a cantilever, and as the centre of gravity of the upward forces is found to be 1.58 feet from front of face wall, the moment in clockwise direction = 6,520 × 3 × 1.58 × 12 = 371,000 in. pds. Moment in opposite direction due to weight of projection = 12,100 in. pds. Hence, net moment = 371,000 — 12,100 = 358,900 in. pds. But, $108 \text{ b. d.}^2 = 358{,}900$, from which d. = 16.6 inches, as compared with total depth of 18 inches, as per Fig. 1.

Area of steel required = .008 × 16.6 × 12 = 1.60 sq. ins. Area of steel from drawing equals 1-inch square bars at 8-in. o.c., equals 1.5 square inches per foot of base. The proper spacing of steel, according to our investigation, would be 1-in. square bars at 7-in. o.c.

Consider the shear at this section, thickness of base being 18 inches. The average shear on 12 inches equals

$$\frac{6{,}520 \times 3}{18 \times 12} = 90.5 \text{ lbs.}$$

As this exceeds the allowable shear in concrete, namely, 60 lbs. per square inch, it is necessary to supply shear reinforcement, apart from the area required to resist tension.

The base between buttresses behind the face wall is figured as a beam supported by the buttresses, to resist the upward or downward pressures, as the case may be. At any section between buttresses we have a net upward pressure behind the wall of 1,950 lbs. per square foot, and an average downward pressure of 2,000 lbs. per square foot on rear foot of base. As span is 13.5 feet,

$$\text{moment} = \frac{2{,}000 \times (13.5)^2 \times 12}{10} = 438{,}000 \text{ in. pds.}$$

$$\text{But, } 108 \text{ b. d.}^2 = 408{,}000$$

$$\text{d.}^2 = \frac{408{,}000}{108 \times 12} = 337$$

$$\text{d.} = 18.35 \text{ inches.}$$

Area of metal required = 18.35 × 12 × .008 = 1.76 square inches, as compared with total depth of 18 inches and area of 1.57 square inches of metal supplied, as per Fig. 1.

In order to take care of the reversal of stress in the rear of the footing it would be advisable to place reinforcing steel at the top and bottom of base plate.

The front and rear projections of base, in case of wing walls, are both designed as cantilever beams. Considering the front projection of the section shown in Fig. 5, we find that the average upward pressure to which the projection is subjected, equals 2,550 lbs. per square foot. The centre of gravity of these upward forces is found to be 1.63 feet from the face of the wall. Therefore, moment of upward forces equals (2,550 × 3) × (1.63 × 12) = 150,000 in. pds.

Resisting moment due to dead weight of projection equals (3 × 1.5 × 150) × 18 = 12,100 in. pds.

Therefore, net moment = 150,000 — 12,100 = 137,900 in. pds. But, $108 \text{ b. d.}^2 = 137{,}900$, from which d. = 10.3 inches.

Area of metal required per foot of wall equals 10.3 × 12 × .008 = .99 square inches.

Area supplied in Fig. 1 equals 1 square inch, and total depth of beam equals 18 inches, from which it appears that there is an excess of concrete at this point.

The design of the rear cantilever is exactly similar to the above and, as may be seen from the figure, the pressures are considerably less than in the case of the front projection. Hence it is evident that, if the same section be used throughout, it will be excessively strong, but perhaps permissible as it facilitates the construction.

The Transcontinental Railway Company, Ottawa, Ont., have recently purchased from the International Engineering Works, Limited, six locomotive boilers, 100 h.p. each. These boilers are to be installed in their various stations and roundhouses along the line.

EARNINGS AND INVESTMENT IN TRANSIT FACILITIES.

THE following is abstracted from a report by Mr. Bion J. Arnold on the transportation facilities of the city of San Francisco. The same traffic expert is investigating traffic conditions in Toronto at the present time, and his report concerning the service, etc., of the Toronto Railway Company will no doubt have a good deal to do with the purchase by the city of the Toronto Street Railway and the Toronto Electric Light Company, since it has been stipulated that they cannot be purchased separately. The following extract, which contains the major part of Mr. Arnold's conclusions and recommendations to the city of San Francisco, is likely, therefore, to be of interest:—

An analysis of growth shows that San Francisco is now growing faster than during the five years before the fire, and at a rate of increase of about 145,000 per decade. The real growth of the city, excluding the effect of the fire, has been at the rate of 54% for the last decade, as against 22% shown by the census. At the present time the city contains about 450,000 people. This population, on the conservative basis assumed, should double in 26 years, and should reach 1,000,000 people in 1945, although it may far exceed this.

San Francisco and the commuter district now has a population of 730,000 people, and has increased 48% in the last decade. This population should double in 23 years, reach 1,000,000 in 1919 and 2,000,000 in 1945.

In spite of this rapid growth, other large cities of the Pacific Coast are growing on the average at a rate probably 50% faster than San Francisco.

As a result of the fire, San Francisco lost 100,000 people permanently. The trans-bay cities gained in population by an amount practically equal to San Francisco's loss. But traffic statistics show that Oakland and its surrounding communities are becoming self-supporting to such an extent that the exodus from San Francisco has practically ceased, and that Oakland will go forward at a normal rate as a supplementary community.

One beneficial result of the fire was a general exodus of residents from the congested inner city to the suburbs, amounting to 66,000 people in the last census period. This has necessarily increased railway earnings and should therefore have made possible correspondingly improved service. The present distribution of population within the 30-minute zone is unusually uniform, except Chinatown and Japtown. The outlying distribution indicates that people will live where proper streets and car-service facilities are provided.

The growth and interchange of population within the district shows that the broader movements of population absolutely disregard municipal boundaries. The idea of a metropolitan district control for the development of utilities and industries is therefore of unusual necessity for San Francisco and the Bay cities.

A review of industrial growth shows that the period of great activity occurring just before the fire was practically recovered by 1910, and that commercial operations now generally exceed those of 1905. The fact that bank clearings suffered no perceptible depression during the disastrous year of the fire indicates the sustaining power of the financial credit of the community.

Manufacturing within the industrial district has alone failed to keep pace with the population within the last decade. In this respect the Bay cities have gained directly from San Francisco's heavy loss. The evident need for a more united industrial district points unmistakably to the practical value of the metropolitan district control idea already suggested.

An analysis of railway earnings shows that they are increasing in proportion to the square of the population; that is, when the population doubles, earnings quadruple. United Railroads earnings alone should double in the next 13½ years; that is, should reach $16,000,000 by 1924-25 and should quadruple by 1942. Earnings per capita are now the highest in the country—$20 per capita for all companies.

In extension of track mileage, San Francisco is at least six years behind the necessities of the growth in population. Trackage should extend at least as fast as the population, if not faster. The total track mileage is now about the same as before the fire, due to abandonments, and the last 15 years shows a slower growth than at any period of the city's history.

The present necessities for track extension require about 15 miles per year up to 1920. This will be just sufficient to complete the extension schedule recommended, and is also required to catch up with the normal growth in population. From 1868 to the time of the Market Street Railway Co. consolidation in 1893, track mileage was extended at the rate of 8.1 miles per year, during the maximum period, 16 miles per year. Since consolidation, the rate of growth has only averaged 3.6 miles per year.

The total operating equipment of all companies in 1911 was 676 cars. Prior to the fire there were many more cars reported, but of smaller capacity, averaging about 30 seats, as against 42 seats at the present time. Several hundred obsolete and worn-out cars were retired in 1907.

The total seating capacity at the present time appears to be about the same as before the fire, but it is a question whether the service capacity, in proportion to traffic, is as great in view of the increased schedule speed, owing to the exodus of population from the inner city to the outlying districts within the last census period.

Assuming the new equipment now on order by the United Railroads had been available to rectify the service requirements of 1911, the future growth of the city until 1920 will require an average addition of from 40 to 50 cars per year. This is a minimum schedule that can be carried out without materially diluting the net earning capacity, as San Francisco has already the highest earning rate from its equipment of any large city in the country. From 1889 to 1896, an average of 67 cars per year was added to the system, with maximum rates of increase within the period of from 140 to 200 per year.

The only way the above increase in equipment called for may be reduced is through the more efficient use of available car-miles by improved routing and by further increase in schedule speed. The size of the car units has about reached a maximum for the streets of this city.

That the extension schedule of track and cars called for here is not unreasonable is further indicated by the fact that out of the annual budget of investment predicted, about 25% will remain up to 1920 for betterments of existing property over and above the investment in new extension and equipment.

An analysis of the purchasing power of the city with respect to its utilities shows that the underlying property valuation is increasing at a slower rate than the necessary railway investment; that is, as the 1.7 power of the increase in population, instead of the square as in the case of earnings. At the very lowest estimate, $3 of capital must be invested for every $1 earned. Under the present bond limit, therefore, the city's ability to purchase or build is becoming more and more inadequate, thus requiring a progressive refunding basis.

The present available purchasing power of the city is approximately $51,000,000 for all purposes, including water supply. By 1930 the total railway investment required will be $62,000,000; by 1950, $123,000,000. This means that over one-third of the total bonding capacity of the city on its present 15% basis would be continually pre-empted for railway investment alone, assuming the city entirely free from debt.

If the city of San Francisco declines to accept the assistance of private capital in financing its utilities both for the present and the future, the conclusion cannot be evaded that a revision of the bond limit must be secured immediately in order to provide the capital necessary for preserving the normal rate of growth of the city as herein predicted.

ADVANTAGES OF OIL FUEL.

Admiral H. I. Cone, United States Navy, in a statement regarding the relative values of oil and coal for steam-raising in the navy, makes clear the following points:—

The advantages of oil as compared with coal are:—

An evaporation per pound of fuel in the ratio of about 14 to 9 (15.5 to 10) and per square foot of heating surface in about the ratio of 10 to 8 (12.5 to 10).

Fuel can be taken aboard more rapidly without manual labor and without interruption to the routine of the ship. The problem of fueling at sea is solved.

Steam for full power can be maintained as readily as for low power. A vessel burning oil is capable of runs at full speed, limited in duration only by the supply of fuel. There is no reduction in speed due to dirty fires or to difficulty in trimming coal from remote bunkers or to exhaustion of the fireroom force.

There are no cinders and the amount of smoke can be controlled.

A considerable reduction in personnel is possible.

The weight and space required for boilers are reduced, first, by the reduction in heating surface required; and, second, by the shortening of firerooms. Consequent on the reduction in heating surface is a decrease in weight and cost of boilers.

Coal and ash-handling gear is eliminated. This renders unnecessary the piercing of the hull for coal trunks and dischargers from the ash-expellers or ash-ejectors.

The stowage and handling of oil are much easier than of coal, and will result in a much cleaner ship, with consequent increase in time available for drills.

The mechanical supply of fuel to the boilers gives a prompt and delicate control of the steam supply, permitting more sudden changes in speed than with coal, which is a tactical advantage.

The nature of fuel oil permits utilization of remote portions of the ship and of constructed spaces for its stowage.

These advantages have long been recognized by the navy, and there have been experiments with liquid fuel dating back as far as 1867. All these experiments have confirmed our belief in the considerable military advantages which will accrue from its use, but until recently it has been impracticable to use it extensively on account of the uncertainty as to the adequacy of its supply and the sufficiency of its distribution among the seaports of the world.

AN EFFICIENT METHOD OF ROAD-OILING.

To spread oil on roads for a distance of twenty miles or more from the starting point, and to spread it at a heat of 200 degrees or more, would seem to be an extremely difficult undertaking, requiring a lot of apparatus and a lot of men. But by the ingenious use of a five-ton truck the road commissioners of Los Angeles county accomplish it with one man and one piece of mechanism.

The truck is fitted with a 1,000 gallon oil tank, and this tank is covered with a coating of asbestos two inches thick to retain the heat. Oil is run into the tank 350 degrees Fahrenheit. Owing to the asbestos protection and the speed the truck can make, it is possible to make a trip of 35 to 40 miles before the oil gets too cold for use.

Air pressure of 60 pounds to the square inch is maintained inside the tank by an air-compressor operated by the same mechanism used to actuate a dumping body for sand and gravel.

Heat from the motor exhaust is used to keep the oil-spreader warm, so that the stuff will not thicken and clog up there. The truck travels fifty miles a day, and the driver says that in 2,000 miles only two involuntary stops were necessary on the road—both caused by dirty gasoline stopping up the fuel line.

The largest crane in the world has just been placed into operation in a Hamburg shipyard. This crane is capable of lifting and distributing 250 tons of material over an area of 182,920 feet. It was the city of Hamburg which, in the year 1888, possessed the largest crane in the world at that time, and now it is again the Hamburg shipyard of Messrs. Blohm and Voss which is able to call the largest crane in the world its own. The development of crane building during the past twenty-five years has been enormous. Germany has taken the lead in the construction of high-capacity cranes, and has delivered the majority of the 140 giant cranes which are in existence. The Deutsche Maschinenfabrik A. G. Duisburg are the constructors of this latest giant. Only two men are required for working the crane. The driver works in a cabin arranged under the load arm of the jib. In order that the crane can be worked safely after darkness a searchlight is fitted near the driver's cabin, by means of which the load is brilliantly illuminated.

The record of trade disputes maintained by the Department of Labor shows that, as is usual at this season, the majority of the disputes occurred pending the adjustment of new wage schedules. These were nearly all of short duration. The mining industry on Vancouver Island was seriously interfered with, more than 3,000 men being out during the whole month through the continuance of the dispute at Ladysmith and the Cumberland mines, and the closing down of the mines in the Nanaimo district. A great number of the disputes of the month occurred among workers in the metal trades. The disputes of May affected upwards of 11,500 employees and accounted for the loss of more than 150,000 working days. Disputes affecting the various classes of municipal employees in Vancouver and affecting also the boot and shoe workers in a number of factories in Quebec were satisfactorily adjusted during the month through the instrumentality of boards under the Industrial Disputes Investigation Act. The Department of Labor also assisted in the adjustment of disputes affecting the employees of the Hydro-Electric Commission in Toronto, and affecting also the longshoremen in Montreal and St. John, N.B. In the latter case a board has been established under the Industrial Disputes Investigation Act.

The Canadian Engineer

ESTABLISHED 1893.

ISSUED WEEKLY in the interests of the CIVIL, MECHANICAL, STRUCTURAL, ELECTRICAL, RAILROAD, MINING, MUNICIPAL, HYDRAULIC, HIGHWAY AND CONSULTING ENGINEERS, SURVEYORS, WATERWORKS SUPERINTENDENTS AND ENGINEERING-CONTRACTORS.

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Postpaid to any address in the Postal Union:

One Year	Six Months	Three Months
$3.00 (12s.)	$1.75 (7s.)	$1.00 (4s.)

Copies Antedating This Issue by More Than One Month, 25 Cents Each.
Copies Antedating This Issue by More Than Six Months, 50 Cents Each.
ADVERTISING RATES ON APPLICATION.

JAMES J. SALMOND—MANAGING DIRECTOR.
H. IRWIN, B.A.Sc., EDITOR. A. E. JENNINGS, ADVERTISING MANAGER.

HEAD OFFICE: 62 Church Street, and Court Street, Toronto, Ont. Telephone Main 7404, 7405 or 7406, branch exchange connecting all departments. Cable Address: "ENGINEER, Toronto."

Montreal Office: Rooms 617 and 628 Transportation Building, T. C. Allum, Editorial Representative, Phone Main 8436.

Winnipeg Office: Room 820, Union Bank Building. Phone M. 2914. G. W. Goodall, Western Manager.

Address all communications to the Company and not to individuals.
Everything affecting the editorial department should be directed to the Editor.
The Canadian Engineer absorbed The Canadian Cement and Concrete Review in 1910.

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Changes of advertisement copy should reach the Head Office two weeks before the date of publication, except in cases where proofs are to be submitted, for which the necessary extra time should be allowed.

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Printed at the Office of The Monetary Times Printing Company, Limited, Toronto, Canada.

Vol. 25. TORONTO, CANADA, JULY 31, 1913. No. 5

CONTENTS OF THIS ISSUE.

FAIR-WAGE CLAUSES IN GOVERNMENT CONTRACTS.

It has been the policy of the Government of Saskatchewan to include in all its contracts a fair-wage schedule. The procedure has met with such favor that workmen of the province are agitating the adoption of such a policy in connection with all contracts entered into by cities and towns for civic improvement. The clauses which appear in the government contracts as directly bearing upon this question are as follows:—

1. The contractor shall employ none but skilled Canadian workmen and their apprentices, and shall not pay less than the current rate of wages in the district where the work is being done, and if there is no current rate, then a fair and reasonable rate. In the event of a dispute arising as to what is the current or a fair and reasonable rate, it shall be determined by the fair-wage officer of the government, whose decision shall be final.

2. Contractors shall post in a conspicuous place on public works under construction the schedule of wages, or the fair-wage clause in their contracts for the protection of the workmen employed.

3. Contractors shall keep a record of payments made to workmen in their employ, the books or documents containing such record shall be open for inspection by the fair-wage officer of the government, at any time it may seem expedient to the minister to have same inspected.

In contracts that are to be carried out in cities and towns a schedule is inserted, setting forth the minimum rate of pay and hours of the various trades and crafts to be employed on the contract. The schedule is based on the current rate of wages for each particular craft in the locality, and is obtained through the courtesy of the contractors and the labor unions interested, and in each case the current wage which is most generally paid is accepted.

The government naturally has control over the rates of wages only on works undertaken by itself or aided by provincial funds; nevertheless, the fact that all contractors on such works must pay a fair and reasonable rate of wages has had the effect of establishing a living wage throughout the province and one that is generally accepted by contractors. On private works the government has no control over the rates of wages to be paid. It has, however, power to enact such legislation as will guarantee to the employee his wages by giving him a preferred lien on the work on which he has been engaged and making the collection of wages from delinquent employers an easy and inexpensive procedure.

WATER vs. RAIL TRANSPORTATION RATES.

Canals have cost Canada $103,400,589. The annual interest charge, reckoned at 3½% would be $3,619,021. In 1912 the cost of maintenance was $1,725,738, making a total of $5,344,759. This means a government contribution of 76.99 cents per ton on the whole Canadian freight tonnage of 1912, or .140 cent per ton mile. Adding to these amounts the actual freight rates, viz., 91.04 cents per ton, or .194 cent per ton mile, gives a total of $11.68 per ton, or .334 cent per ton per mile.

Mr. J. L. Payne, Controller of Statistics, Ottawa, makes the following comparison between rail and water rates, basing his remarks upon the transportation of wheat between Fort William and Montreal, via both routes.

The average rate on waterborne wheat between these points in 1912 was 5.774 cents per bushel, of $1.92 per ton. To this should be added the contribution by government of .140 cent per ton per mile, equal to $1.72 per ton, making the total $3.64 per ton. The rail rate of the Canadian Pacific Railway between Fort William and Montreal is uniformly $4 per ton, or .402 cent per ton per mile. The average rail rate of all the railways of the West on wheat is not higher. On a longer haul, say, from Winnipeg to St. John, New Brunswick, it is even lower; so that the comparison is fair. Thus, we have on this statement of facts a water rate of $3.64 per ton as compared with a rate of $4 per ton by rail. That comparison, however, is based on an average water rate on wheat of 5.774 cents per bushel. The maximum water rate for the season of 1912 between the same points was 8 cents per bushel, and at that rate the charges by water were 29 cents per ton higher than were the current charges by rail. A fair conclusion is that, on the whole, the water rate paid by the shipper is lower on certain commodities which are peculiarly suitable for transportation in steamers; but there is not a material difference between water and rail rates when all the facts and conditions are taken into account. The difference in favor of the water rate is created wholly by the fact that a considerable part of the actual cost of transportation by water is paid by the people at large.

EDITORIAL COMMENT.

Notable among the week's proceedings of engineering interest is the government call for tenders, for the Toronto harbor development, the plans and specifications for which are now complete. They pertain to seawall, breakwater, ship canal, turning-basin, retaining walls, etc. The seawall is to be 17,295 feet in length—over 3¼ miles—and is to be built in eleven sections. The structure will be of sheet piling and timber with a superstructure of concrete. The breakwater will be 18,600 feet in length and will be of timber crib work and concrete superstructure. The ship channel and turning-basin will be approximately 16,705 feet long and the whole area will be dredged to a depth of 24 feet. The retaining wall will be 6,894 feet in length.

* * * *

Ottawa and vicinity are interested in the expropriation proceedings recently instituted by the Ontario Hydro-Electric Power Commission in connection with the water-power rights at Chats Falls, on the Ottawa River, some thirty miles west of the city. A private company holds the present power rights by government lease granted two years ago. The price of relinquishment asked by them is some seven times the amount offered by the Ontario Government. The Ontario Railway and Municipal Board has the case before it, and evidence will be heard in September.

It is the intention of the Commission to use the power at Chats Falls as an Ottawa Valley and Eastern Ontario extension of the provincial system, over 100,000 horse-power being available for development in the district.

LETTERS TO THE EDITOR.

An Association for Municipal Engineers.

Sir,—Mr. R. O. Wynne-Roberts' letter in your issue of the 15th inst., has spoken the mind of many municipal engineers now engaged in the Dominion, and he evidently speaks from a knowledge of inter-communication between engineers, as I can trace his name through many English engineering associations.

Your editorial, sir, conveys a suggestion with reference to the Canadian Society of Civil Engineers, and one that every trained municipal engineer welcomes, the more so that he would be enabled to join an established and recognized community of engineers whose branches reach far out in the engineering world, and who possess amongst its members the eminent engineers of Canada.

The Dominion is developing rapidly, townships are springing up like mushrooms and the demand for public utilities in water, sewerage and roads, electric lighting and power, etc., and every other necessity for public health is being asserted in no unmistakable manner, that the time has come when none but the qualified theoretical and practically trained man can be looked upon as the successful candidate, and the competition for the appointments should lie amongst such men.

This branch of engineering is so important to the public well-being, both financially and administratively, that some steps should be taken to have it set upon a better recognized basis. Its members are men with Canadian experience, geological and climatic, whose training has been conducted upon sound scientific and practical lines, and whose experience has been gained by constant and businesslike study.

The question of the establishment of such an association or institution is surrounded with difficulties which can be overcome the more easily by subdivision. I mean that the Dominion is so extensive that the ordinary salaried engineer cannot afford to travel from coast to coast each year to attend conferences. This can be met, I suggest, by a central body representative of the provinces, whose labors shall be directed by the provincial branches; these branches, for economy's sake, to hold their meetings at various cities within their province.

If the institution could become a recognized body by the government by charter, it would materially increase its value and importance, and the aid which would be rendered from government engineering officials would add prestige to its personnel.

Under such conditions it would be a matter of easy negotiation to put forth legislation in favor of municipalities bearing the costs of their engineer's attendance at conferences throughout the Dominion, within reason, of course, i.e., an annual meeting of three to six days' period.

The status of the individual as a member should be taken care of, and various degrees of membership established—say, for a period of one year from the date of formation, chief municipal engineers would be admitted as full members, chief assistants and assistants of eight years' experience as associate members, and younger members of engineering municipal staffs as graduates.

After the first year has expired, examinations for entry as graduates or students on the one hand, and for associate members on the other, should be established. Of course, the latter examination would qualify the associate member for full membership upon his obtaining a town or city engineership.

There is an immense amount of labor to be wrought in the successful launching of such an institution, but I have no fear of its issue if the determination of the engineer is turned to it in the same spirit that he tackles the problems of his district, overcoming many of nature's obstacles, and often harnessing them for the benefit of mankind.

PRO BONO PUBLICO.

Winnipeg, July 21st, 1913.

* * * *

Concerning Toronto's Filtration Plant Extension.

Sir,—In view of the City Council's decision to spend $1,000,000 for a filtration plant at the Island, in order to avoid an expenditure of perhaps $2,000,000 for a new intake or tunnel which the placing of the addition on the mainland would entail, we would like an interesting proposal, which we have made, to appear in the columns of your journal.

It should be pointed out that it has only been made after two years' study of the existing conditions, and after a careful perusal of the various reports published, including that recently issued by Commissioner of Works Harris, Drs. Hastings and Nasmith, appearing on page 184 of July 17th issue of *The Canadian Engineer*. We would make reference particularly to several of the closing paragraphs of this report in which Garrison Common is mentioned as an ideal location for the installation of a mechanical filtration plant; but that the sum that has already been invested in the Island plant necessitated the retention of its use; also the reference to the formation of the Island being such as to render it an undesirable location for permanent construction of this nature, and the very extensive operations, which the Harbor Commissioners purpose undertaking, being liable to imperil the present or any future installation which might be established there. The continuity of a filtered water supply for 365 days per year is stated to be the dominant factor in the consideration of the proposition.

These sections of the report lead one to believe that, if the Island is undesirable for the present $800,000 construction, it will be much more undesirable for a $1,800,000 investment, considering the sand formation and the indefiniteness of the Harbor Commissioners' future operations conflicting with it. Further, the ideal site for the filter plant being on the mainland, it appears to the writer that the present filtration plant might well be retained in connection with the city water supply for use as a basin to effect settlement of the water before filtration, thus removing the troublesome sand problem which must be contended with. The new filter plant could then be installed adjoining the main pumping station, and the raw water filtered after being drawn through the tunnel, thus eliminating a constant source of danger to the pure water supply, viz., the passage of water through the tunnel under the polluted waters of the Bay. Such a plant could be located on the vacant land owned by the city between the present pumping station and the railroad tracks to the north, convenient to the mechanical operators of the former, and in a position entailing a minimum of cost for the transportation of stores and supplies.

The proposal which was recently submitted by the Bell Filtration Company covers the installation of a filter plant of 65,000,000 gallons minimum, and 96,000,000 gallons maximum capacity upon the above-mentioned site, to be installed without delay and to be in operation in about fifteen months. Without going into details of equipment, etc., it might be stated that under the proposed method the water would be first settled by the Island basins, would flow by gravity to the main pumping station, and would then be pumped directly through the filters to the city mains.

The chief advantages attendant upon this scheme are those of insurance against interrupted operation, such as might be occasioned by alterations to the Island, and the safe-guarding of the supply against dangers of pollution by Bay water.

In the event of any change being desirable at any time, the whole of this plant can be removed practically without interruption, thus increasing the value of it as an asset to the city.

H. W. COWAN.

Toronto, July 23rd, 1913.

A REMARKABLE PAVEMENT TEST.

Bereft of its concrete base and of the roadway itself, something like 100 square yards of brick pavement on Dunham Road, near Cleveland, are projecting over the void with nothing to hold them in position but an excellent job of cement grouting between the bricks themselves.

This spectacular test of Cuyahoga County's road-building methods came to pass through the agency of a recent freshet in Tinker's Creek, a small stream skirting the road. Retaining wall 275 feet in length was swept away and the earth undermined for nearly 100 feet. The concrete base was next to go, leaving the brick bare for a distance of 80 feet. The greatest breadth of the brick overhang is seven feet.

Washout Under a 14-Foot Brick Road in Ohio.

So solid was the course of grouted brick that it was a job of no small difficulty to remove two bricks in order to erect posts for a warning fence. After the holes had been made, the engineer in charge did not hesitate to drive his auto upon the overhang and pose beneath it. At first it was planned to break the pavement down and rebuild it after the road had been filled, but the solidarity of the structure has brought about an alteration of plans and now county engineers actually contemplate building the road up to the pavement without disturbing the latter.

Cuyahoga County has over 400 miles of rural brick highway, counting the 50 miles to be installed during the current year. Macadam was long ago abandoned as unsuited to the heavy and growing automobile traffic. The construction of a heavy, solid base and utmost care in the application of a cement grout filler have been the keynotes of successful road construction in Cuyahoga County.

PREVENTION OF LANDSLIDES IN CONSTRUCTION WORK.

By Geo. S. Rice.
Chief Mining Engineer, U.S. Bureau of Mines, Pittsburg, Pa.

THE slides in the Culebra Cut which have so severely handicapped operations on the Panama Canal construction, and the likelihood of them continuing to occur, as such a conclusion may be arrived at from a perusal of the report for 1912 of the Isthmian Canal Commission, suggests the advisability of preventive measures, as far as the geological formation of the isthmus will permit. Mr. Rice suggests the utilization of a process used in shaft sinking and tunnel work—that of erecting an underground retaining wall which would have a tendency to prevent the formation of a slide by taking care of the unbalanced pressures due to deep excavation. His suggestion forms the basis of a paper read before the Western Society of Engineers, Chicago, on May 12th, from which the following abstract is made:—

While the method of filling cavities and rock crevices behind tunnel lining with cement grout has long been employed, a special application called the cementation process has been highly developed in France for sinking through porous and creviced water-bearing strata. Briefly, it consists of drilling a series of holes surrounding the shaft location through the porous strata to the more of less impervious coal measures, and pumping in cement grout under high pressure. The pumping may be either continuous, as the drilling proceeds, or (as in later undertakings was found to be better) in stages at intervals alternating with drilling every 16 ft. By this method a cylinder of cemented material is constructed within which the shaft can be sunk. In the earlier undertakings four drill holes were used, but for later shaft sinkings six holes were employed in a circle of 24 ft. diameter.

To prevent leakage to the surface of the injected grouting, a pit is first dug for each bore-hole through the loose earth and concrete placed tightly about a 12-in. standpipe, the top of which is capped. The cap has a stuffing-box, through which passes a grouting pipe that can be pushed to near the bottom of the hole. The pipe is connected with the pump, and the latter with the cement mixer. Before injection of cement begins, clear water is pumped through.

It has been found necessary to use only the finest ground cement, and employ pressures as high as 750 lb. per sq. in. to insure the thorough permeation of the cement into the small crevices and bedding planes of the strata. The cleaning out of all mud coating on the bore-hole is also found necessary. To this end it is the practice to drill the hole below the standpipe, about 7 in. diameter, and then ream to 10 in.

The water-bearing strata consists of marls or fissured chalks which are sometimes argillaceous. They are soft enough to be bored with an auger drill turned by power. The process has been so successful that it is supplanting the freezing system for sinking through highly water-bearing strata in northern France and Belgium.

Constructing Underground Retaining Walls.—The success achieved with the above process appears to offer possibilities in solidifying the slopes of unstable strata, at least sufficiently to prevent movement from occurring. The holes filled with concrete, reinforced with iron bars, would serve as deep-seated massive piles. Why not extend this principle and drill inclined holes to solid strata, and insert in them heavy reinforcing bars which, when surrounded with cement, would act as diagonals or tension members?

A further development was to "spring" the holes at the bottom by shooting with dynamite. This would open up crevices, permitting a more extensive cementation, and would provide an enlargement which would furnish anchorage for the tie bars. The upper end of the tie bar is to be held by a concrete capping. Thus the combination of vertical concrete posts and inclined metal ties (going deep enough to reach solid strata), with the ground cemented between, would furnish a triangular dam, or retaining wall, which should have great strength against lateral pressure.

The nearer the holes, the more thorough would be the cementation. The only limit would be that of cost. The system, if applied extensively, would be costly. But it would only be considered where the cost of repairing damage to an engineering work by an extensive landslide would be vastly greater.

In proposing the scheme for checking, or rather preventing slides, the writer has had three main thoughts in mind: 1, as far as possible there should be drainage; 2, there should be a subdivision of the slopes from which the slides are liable to come; 3, there should be formed an underground dam, to prevent the foot of a slope from moving, and also to keep the water of the canal from circulating through the material. It is very much more destructive to the somewhat soluble walls to have water constantly entering and leaving the crevices through wave action, than if the ground water is merely held quiescent.

The scheme is as follows:—

1. To drill a series of holes along lines parallel with the axis of the canal, these holes to be both vertical and inclined, and go deep enough to reach firm strata below the level of the bottom of the canal. The depth of the holes might need to be 100 ft. or over 150 ft.

2. Cement grout to be forced into these holes under pressures of 750 to 1,000 lb. per sq. in., so that the cement will penetrate all the fissures, making the mass impervious to water, and also binding the rock together.

3. Steel rods, 3 in. diameter or more, to be grouted into the holes.

4. Before the steel bars have been placed, dynamite is to be fired in the bottom of each hole to make an enlarged space in the firm stratum which the holes should reach. These will provide anchorage at the bottom. The rods will thus act as reinforcement to the cemented zone; and the rods in the inclined holes will serve as tension members of the wall. The latter rods will therefore be made much heavier than the others. The rods are to have nuts and washers or to be upset at each end. The upper ends are to be fastened in a concrete capping over the top of the "dam."

This method cannot be applied to ground that has begun to move. It cannot be applied to ground that is actually moving. Moreover, the wall must go sufficiently deep to get into solid strata. But there is nothing except cost to prevent such an underground dam from going as deep as seems desirable, or to make the holes as large or the tie rods as heavy as desired. It would be desirable to try the method beyond the present slide areas in order to determine the obstacles and necessities of the case. The work could be pushed from either edge into the slide area. Intermediate ground walls could be constructed further up the slopes, so as to lessen the weight and also to prevent water which might enter above from working down into the larger mass below. Accompanying these dams, underground horizontal drifts might in some cases be put into the slopes to drain the ground.

THE CONSULTING ENGINEER AND THE MUNICIPAL ENGINEER.

By H. C. H. Shenton.

THERE should be no antagonism between the consulting engineer and the municipal engineer. They are both members of the same profession, and for that reason should carefully study their common interest. Signs are not wanting that the time is ripe for combination among engineers with the object of improving their standing and general welfare, and a paper read by Mr. Shenton before a meeting of the Institute of Municipal Engineers in London, on June 25th last, has for its object the furthering of such co-operation.

There is absolutely no difference in status between the two branches of the profession. We are all engineers, we all start level, we all receive much the same education and training, and eventually elect to specialize or to take up municipal appointments, or work in some other branch of the profession not under present consideration. Without doubt, a great municipal engineer of long experience is a better man professionally than a consulting engineer of smaller experience, and similarly a great consulting engineer is professionally of more importance than a municipal engineer of lesser attainments. This may be a truism, but it needs to be understood properly in order that, when they have to work together, the senior man (as regards experience and attainments) should take the lead without any feeling on the part of his friend, the consultant or salaried official, as the case may be, that he is being treated with want of proper consideration.

The Engineer's Qualifications.—The combination of all classes of engineers into one body is not beyond hope, but the combination of engineers of a particular class should not only be quite possible, but may well be attempted at the present time. For instance, all engineers holding municipal appointments could combine very easily, but in the author's opinion such combination would be incomplete, because it would leave out a very large number of men who advise as to the construction of some of the most important works of local authorities—viz., the consulting engineers. A difficulty at once presents itself as to who should be included in such an organization and who should be excluded. It is not to be denied that there is a certain number of consulting engineers whose experience does not entitle them to call themselves "specialists," and whose knowledge of the subjects upon which they undertake to give advice is inferior to that of the average municipal engineer; persons whose knowledge on all matters not pertaining to municipal work may or may not be great, but who are looked upon with considerable disfavor, and justly so, by those municipal engineers with whom they may have to work. Any man, however limited his knowledge may be, is at the present time able to write the letters C.E. after his name, take an office and give advice, and if he possesses influential friends and a plausible manner he stands a good chance of obtaining work with which he is quite unqualified to deal. There ought to be some method whereby such persons should be prevented from advising as to the spending of public money. On the other hand (and it is necessary to be perfectly frank) there are many persons holding positions in municipal or district council offices who by no stretch of imagination can be considered worthy of the title of "Engineer." In the author's opinion a district surveyor is, or should be, an engineer; yet in small urban and rural districts, and even perhaps in some boroughs, where the salaries paid to the district surveyors are too small to tempt experienced men to act, men of a very inferior type as regards experience are frequently employed. Ignorant councillors are frequently of opinion that if a man is a good bricklayer or tradesman he is an engineer, and they employ him as their surveyor partly from motives of mistaken economy, and largely because they prefer to have someone to whom they can dictate, and whom they will treat with very little respect, thinking that thereby they, being omniscient in all matters pertaining to the surveyor's department, may have the ruling hand. In this way the dignity of the engineer's position is lowered, and an enormous waste of public money takes place.

The properly trained and qualified man, whether he is a municipal of a consulting engineer, looks with considerable dislike on the two classes of amateur engineer mentioned, and he would like to see the profession so organized that the incompetent person should find it as difficult to call himself an engineer as to call himself a lawyer or a doctor. However, on this point one must carefully avoid coming to a false conclusion. There are many good engineers whose early training was that of a different calling, but who possessed such ability that they forced themselves forward, gaining experience, it may be, in a very humble station, and finally taking their places in the profession as honored members with absolute justice. It is therefore necessary to consider whether many of the men who cause so much annoyance by undertaking work for which they can show no proper qualifications, and by doing it for an entirely insufficient remuneration, are not often persons of considerable ability whom it would be difficult and unwise to treat as being completely outside our ranks. The very fact that they possess the assurance to undertake engineering work suggests the possession of one of the qualities most necessary to all engineers—viz., pluck. These men, whatever their previous condition may have been, may be quite capable of gaining the necessary experience and training to qualify them as engineers, but till they have done so, whatever their age and position may be, they can only be regarded as juniors, and should be treated accordingly. In that case the local authority who tried to employ such unqualified persons in chief positions, or as consultants, should be prevented in the same way as they could be prevented from appointing a medical student to the position of medical officer. Leaving out of our consideration the inexperienced class of men on both sides, we may consider the remainder as belonging to one class, and these ought to be able to unite for their common good.

The Engineer's Remuneration.—The most important question at the present time is that of remuneration. No engineer ought to be made to work for insufficient payment. The municipal engineer is sometimes a perfectly competent specialist, and can advise his council better than any consultant upon a given matter outside his ordinary duties, but when he does so without receiving proper fees such as the consultant would charge he is doing the profession serious harm. He is ranking himself with a sort of consultant who prepares schemes for nothing, or who obtains work by offering to do it at a reduced commission. In the abstract one must condemn such practices utterly, but such is the unfortunate condition of the profession, owing, however, entirely to lack of organization, that the municipal engineer may be forced to do work quite outside his ordinary duties without charge, in order to keep his position, and the consultant may be forced to work for nothing in the hope of being able to make a living some day. This is entirely wrong, but it has been done. There is only one remedy: we, as engineers, should combine and organize for registration, so that the incompetent men may be excluded from the ranks of those who act in chief positions, and when this has been done we shall be able to refuse to work except to a proper scale of charges; and, moreover, we ought to be prevented from doing so. Means must be devised whereby it is made impossible for local authorities to obtain the services of their salaried officials or of consultants except by paying proper salaries or proper fees. In this matter the assistance of the Local Government Board is required, and it is not beyond hope that such assistance would be given if once the profession were properly organized. It is perfectly clear that the board have the greatest dislike to the employment of unsuitable persons by local authorities, and that even at the present time, as far as their powers permit them, they do very good work in refusing to sanction loans for unsuitable schemes prepared by incompetent persons.

It is urged at times that the municipal engineer is unfairly taking up the work of the consultant. This, in the author's opinion, is quite incorrect, for it is obviously the bounden duty of a municipal engineer to give his best services to his employers, and so long as he can do the work, and his remuneration is adequate, the consulting engineer has no grounds for complaint. Where a consultant is called in to advise a local authority, his work should be done in such a way as to assist and strengthen the position of the municipal engineer, and similarly the municipal engineer should work with the consultant so as to ensure the success of his work in every possible way, both sides avoiding doing anything likely to bring the profession into disrepute. In the author's experience these relations are generally quite satisfactory, but it would be of considerable interest to learn the experience of others upon this point.

A consulting engineer is sometimes called in by an authority whose surveyor is a man of knowledge and experience, but whose services are entirely undervalued and underpaid by his council, and whose position is the reverse of pleasant. It is possible in such a case for the consultant to insist upon proper respect being paid to such a man, and he should make it his business to do so and to help him to advancement in every way possible, as the council are likely to attach importance to the action of the consultant and to the degree of respect with which he treats the surveyor.

It may be asked whether it is possible, after all, to make an exact distinction between the man who is an engineer and the man who is not? In the author's opinion there is no difficulty whatever in deciding whether a man is a qualified municipal engineer. It is not at the present time a question of examinations passed, of pupilage, or of membership of societies and institutions. It is simply and solely a matter of training and experience, and unless a man has been occupied for an extended period on municipal engineering work he cannot by any possibility be rightly called a municipal engineer. A civil engineer is not necessarily a municipal engineer any more than a doctor is necessarily a medical officer. Similarly with regard to consultants the consulting engineer is a specialist, and this implies that he has made a special and extended study of some particular branch of engineering, such as waterworks, sewerage, or electrical work. He is an expert in some particular work, and it is obvious that he is sailing under false colors if he calls himself an expert unless his knowledge and experience of the particular work he undertakes are extensive. It is very desirable that engineers in private practice who undertake to do work upon which public money is spent should be carefully registered, not simply as engineers, for that term is too vague, but as water engineers, gas engineers, sewerage engineers, tramway engineers, etc., as the case may be. It is, after all, a simple matter for a man who poses, say, as a gas engineer, to show that his experience is such as to qualify him to give advice on that subject; if he cannot he is not fit to advise as to the spending of public money on gasworks. Municipal engineers can help their consulting brethren on this point greatly by urging their authorities to see that their consultants on any particular work are really specialists for that work, and not for something else. They can also assist very materially by joining energetically as a body in any scheme for combination which may be forthcoming for the better organization of the profession.

Points for Discussion.—(1) The proper qualifications of the municipal engineer.

(2) The proper qualifications of the consulting engineer.

(3) How to prevent local authorities from employing:
(*a*) Incompetent persons in municipal engineers' positions:
(*b*) Incompetent persons as consulting engineers.

(4) The inclusion or exclusion on municipal work of persons whose training and experience is insufficient to qualify them as engineers. Should these persons be considered as juniors qualifying for the position of engineer, or how should they be regarded?

(5) The position of the municipal engineer who is doing consulting work without receiving proper payment.

(6) The position of the consulting engineer who works without receiving proper payment.

(7) The ways in which the consulting engineer and the municipal engineer may help each other.

(8) The better remuneration of municipal engineers, and the combination of both classes of engineers for the improvement of their profession.

The area of the Forest Reserves in the Union of South Africa in December, 1911, was 1,799,550 acres. Besides this, there were also 42,587 acres reserved for growing railway ties, on which railway funds alone were expended, making a total reserved area of 1,842,137 acres. Forest surveys are being made for the demarcation of new reserves, and existing reserves are being protected from fire by burning or cutting fire-belts around the reserves and by planting up their perimeters with trees of the less inflammable species. As a result of these precautions there were burned during the season of 1911 only seven hundred acres, or 0.04 per cent. of the total area.

The fourth International Road Congress will be held at Munich in 1916, as a result of an invitation from the Imperial German Government, seconded by a representative of the Bavarian Government.

THE ROD AND MERCHANT MILLS OF THE DOMINION IRON AND STEEL COMPANY, LIMITED.

Believing that all readers of *The Canadian Engineer* are interested in the progress and development of the Dominion Steel Corporation, now the largest metallurgical enterprise in Canada, we have arranged for a series of descriptive articles, each one of which will be devoted to some particular unit or group of units that goes to make up the complete plant, which now includes facilities and appliances of the most modern description for all purposes, from the winning of coal and ore to the manufacture of quite highly developed forms of steel products.

Instead of taking these in the sequence of the processes to which they relate or of the time of their installation, we propose to take some of the newer items first, grouping with them some of the earlier parts of the plant which are closely related to them.

The plan which accompanies this article shows the layout of the Steel Company's rod and merchant mills. The rod mill was built in the year of 1904, has since been in practically continuous operation, has turned out over half a million tons of rods, and has incidentally made what are believed to be world's records for production for a day, a month and a year.

This mill is of the type known as the Morgan continuous rod mill. The roll trains consist of six stands of 12-inch roughing rolls and eight stands of 10-inch finishing rolls. The roughing train is driven directly from the engine by a system of pinions geared to the main shaft. The finishing train is driven by a pair of 48-inch double belts from a 22-foot flywheel. The engine was built by Ehrhardt & Sehmer, and is compound condensing, with cylinders of 35½-inch and 59-inch by 51¼-inch stroke.

The rods are delivered from the finishing mills through tubes to four reels, upon which they are coiled hot. From these reels they are dropped upon a flat, motor-driven bundle conveyer inclining upwards from the point where it receives the coils, below the main floor level, to the end of the bundle conveyer, about 150 feet distant. Here they are transferred to the bundle-cooling carrier, which conveys them about 375 feet to the bundling shed. By the time this is reached the rods are cool enough to handle and are tied up for shipment.

Rods of all sizes, from No. 5 wire gauge to ⅜-inch in diameter, are rolled in this mill.

The billets used are 30 feet long by 1¾ inches square, made in the company's billet mill, which will be described in another article.

Parallel with the rod mill is the new merchant mill, which is not only the latest of the finishing units to be put in, but is also from the very latest designs of the Morgan Construction Company, of Worcester, Mass., who constructed both mills. It consists of one train of six 12-inch continuous roughing stands and three Belgian trains of two stands each, one with a pair of 9½-inch and the other with a pair of 10½-inch rolls.

The roughing mill is equipped with feed-rolls, emergency shear, etc., and is driven by a system of pinions geared direct to a 36-inch by 48-inch simple engine.

The finishing mill is driven by two 52-inch double belts from the flywheel of a 24-inch by 48-inch twin simple engine.

Both engines were built by the Robb Engineering Company, Limited, of Amherst, N.S., and are of the piston valve type, designed to run at speeds varying from 60 to 100 R.P.M., and are fitted with Schutte-Koerting engine safety stop valves.

The finishing mill is equipped with automatic repeaters on the delivery side, emergency shears, etc., and is arranged to deliver either to a cooling bed or to pouring reels.

The pouring reels are similar to those used on the rod mill, but can take squares up to ¾ inch and rounds up to ⅞ inch. They deliver the coils to a motor-driven, flat bundle conveyer 100 feet long. This is beneath the floor, and passes diagonally across the mill and inclines upward to the bundle cooling hook carrier, which is driven from the same motor, and automatically picks up the bundles and conveys them 554 feet to the bundling shed. The bundle carrier has a capacity of 88 bundles, and speed can be varied to suit the stock, giving ample time for it to cool thoroughly by the time it reaches the coil-bundling shed, from which it is shipped. Part of the smaller rods, which are made into wire or nails, is transferred by a second bundle carrier to the cleaning department of the wire mill, which will be described later in an article upon the wire and nail mills. These conveyers are much the same design as those in the rod mill.

The cooling-bed is the Edwards inclined mechanical escapement type, with a capacity for eighteen pieces 360 feet long. The pieces are conveyed to the upper side of the cooling-bed on a cone roller conveyer, and are delivered to the shear by a roller table conveyer on the lower side. Both conveyers extend the full length of the bed. The pieces can be cut to any length. After shearing the pieces are pushed by a steam kick-off to the scale, which is beside the shear-table, and is provided with suitable cradles to hold the bars.

The shear is vertical, motor-driven, and has a capacity of fifteen bars ¾-inch in diameter, or their equivalent.

The whole mill floor is commanded by an 85-foot electric overhead travelling crane of fifteen tons' capacity. This is used for all the purposes of the mill, including the carrying of finished stock from scales to bundling floor or to cars for shipment. Among the other accessories of this mill are a five-spindle motor-driven bar-twister, built in the company's shops, and a motor-driven shear for cutting cold bars from stock. A standard gauge railway track extends about 400 feet into the mill building, upon which cars are run in for loading direct from the stock floor.

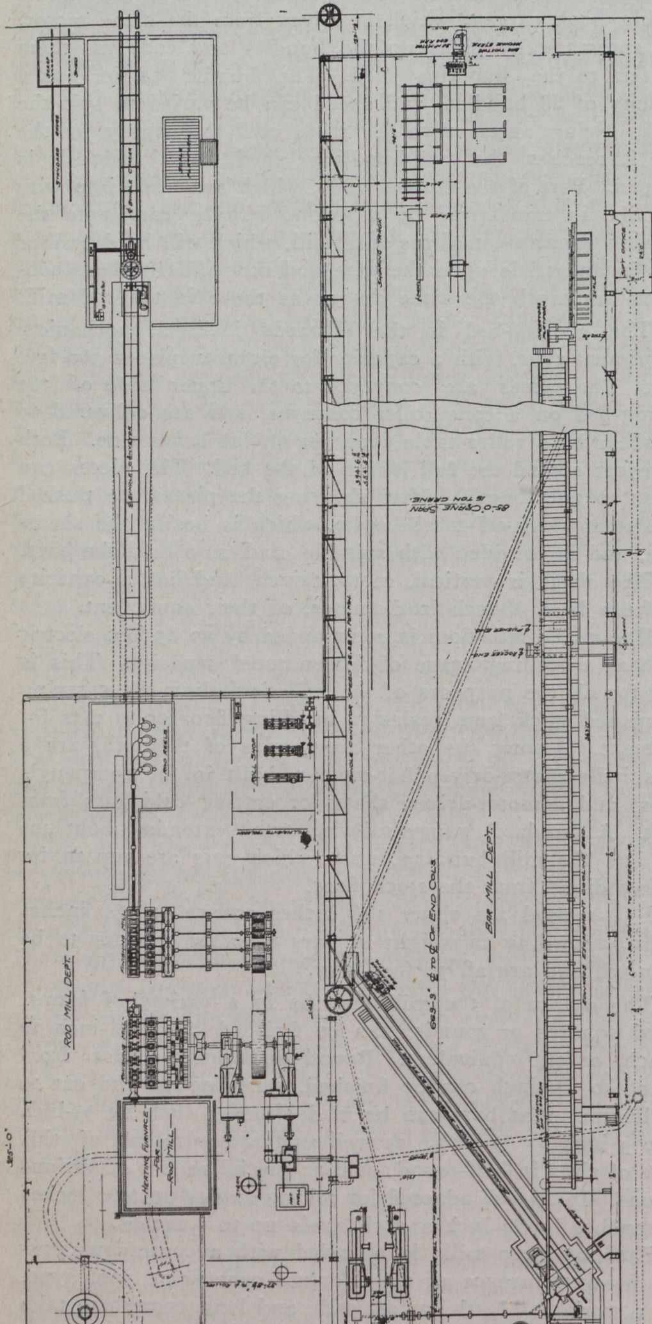
Billets used are either 1¾ inches square or 2½ inches square, according to weight of bars or other sections to be produced, and are all 30 feet long.

The output of the mill may be in a variety of forms. Coiled squares or rounds can be finished from ¼-inch to ⅞-inch, or the equivalent. Round and square bars from ¼-inch to 1½-inch can be finished, straightened and cut to any length. Flat bars can be made from ½-inch by ⅛-inch up to 3 inch by ½ inch, as well as the equivalent of this range of sizes in half-round, oval or special shapes of various sections. It is well adapted for rolling angles up to 2 inches by 2 inches by ⅜ inch and channels up to 3 inches.

Each of these mills is provided with a continuous gas-fired heating furnace of the Morgan suspension roof type, with a working hearth 32 feet wide and long enough to take 90 2½-inch or 162 1¾-inch billets. Both furnaces are supplied with gas from Morgan automatic gas producers, of which there are five connected up in one battery. Coal is delivered direct to the charging floor from cars placed upon an elevated trestle parallel with the producer building and connected with the main track system.

Billets for use in these mills are stored in a yard adjoining the end of the mill buildings, and served by an overhead travelling crane 36 feet span, with runway 325 feet long. The bridge and trolley are motor-driven, and lift and carry ten billets at once. From this yard they are transferred by motor-driven roller conveyers to the heating furnaces.

The roll-turning department is conveniently located in the south-west corner of the rod mill building, and serves both the rod mill and bar mill. Steam for the mill engines is provided principally from a newly-constructed boiler plant provided with automatic stokers, chain grates, etc. A full description of these will be given in an article upon the power system. Mill-cooling water is impounded in a cooling reservoir, the return water flowing in an open flume arranged with baffles, and is repumped to the mills. This will be described in a later article under Water System.



Plan of the Rod and Merchant Mills of the Dominion Iron and Steel Company.

Fresh water is used on the furnace coolers, this being sufficient to act as a make-up for the losses due to evaporation and leakage. Great care was exercised in designing the waste water conduits beneath the rolls to make them self-cleaning. All the scale is carried to the scale-pit and deposited in a self-draining scale-box, which is lifted by crane and discharged to cars. The overflow water from the scale-pit returns to the cooling reservoir.

Small scrap is balled in a scrap-balling machine, while cobbles and the larger scrap is sheared up and all loaded direct into charging boxes in readiness for use in the open-hearth furnaces.

The buildings in which these mills are housed are of standard steel construction. The rod mill building is 90 feet span by 325 feet long, and the merchant mill building 88 feet 6 inches span by 663 feet 3 inches long. The side walls of the rod mill building are covered with reinforced concrete. The side walls of the merchant mill building and the roofs of both buildings are covered with corrugated galvanized iron. Both are well provided with light, especially the merchant mill, which has continuous windows 10 feet wide of heavy wired glass extending full length of the building, and set high up in the wall so as to give the maximum of light with the minimum of breakage.

KAMINISTIQUIA POWER COMPANY

The decision of the Kaministiquia Power Company to carry out further extensions to its plant at Fort William, thus increasing its power capacity is another evidence of the unusually active growth which is taking place in the advantageously-located twin cities of Fort William and Port Arthur.

The Kaministiquia Power Company was incorporated in 1905, when it purchased from the Ontario Government the Kababeka Falls on the Kaministiquia River, 18 miles from Port Arthur and Fort William, Ont., and immediately commenced the development of this water power. The initial development was completed in December, 1906, and subsequently has been added to. There are now installed three electrical units of 3,750 kilowatts, each making a total equivalent to about 15,000 horsepower. The hydraulic development may possibly have been made in three units, of about 7,000 horsepower each.

The present hydraulic development is equal to a round 20,000 horsepower, of which there was added in 1911, one unit of 7,000 horsepower capacity in turbines, generators, etc., and the extension was made to the power house to accommodate this extra equipment.

It will be seen, therefore, that at the present time the company has a hydraulic development with a capacity of 20,000 horsepower and plant and machinery installed with a capacity of 15,000 horsepower. It is the intention to proceed with a hydro-development of 10,000 additional horsepower, making a total development of 30,000 horsepower. At the same time it will install an additional unit of electrical machinery with a capacity of 15,000 horsepower, thus doubling the present electrical capacity and making a total of 30,000. The company will thus be able to take advantage of the entire power at its disposal. It is said that the undertaking will involve an additional expenditure of about $1,000,000. It is the intention to begin work in the immediate future and it is expected that the undertaking will be completed at the close of 1915.

The Kaministiquia Power Company is in a somewhat unusual position in this that it does not enter into competition with the Hydro-Electric Power Commission of Ontario. Instead, it supplies the power to the Commission, the Commission in turn supplying current to the city of Port Arthur for municipal and industrial purposes. The Kaministiquia Company supplies Fort William direct.

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Book Reviews:

BOOK REVIEWS.

Gas Engines and Producers.—By Lionel S. Marks and Samuel S. Wyer. Publishers, American School of Correspondence, Chicago. 151+62 pages; 6x9 inches; illustratd. Price, $1.00.

This book is divided into Parts I. and II., dealing with gas and oil engines, and Part III., which treats of gas producers.

It will no doubt be news to many to learn that as long ago as 1678 the Abbé Hautefeuille suggested a form of internal combustion motor in which gunpowder was to be utilized; but 1860 was the earliest date at which any really practicable motor of this type was devised.

The first part of the book, following a brief historical sketch, is devoted to a description of several different makes of engines, and illustrations are given which clearly show their action.

The introduction states that this publication is "designed to present theoretical and practical information in such form as to appeal both to the engineer and to the untrained person, who is merely interested in the subject," but, from the language employed, the latter would need to have a moderate acquaintance with engines, and also of elementary physics and algebra, in order to read it intelligently and derive any benefit from it. For example, on page 25 an equation for finding the temperature of a charge of explosive mixture at the end of compression, assuming a certain initial temperature is given, in which the assumed initial temperature of 60° F., is reduced to an absolute temperature by adding 461 to the Fahrenheit reading, but no mention is made of what the quantity 461 denotes, or why it is thus added.

In the section to which the foregoing paragraph refers the book would be somewhat improved by stating clearly in a table what the various symbols P_1, P_2, P_3, V_1, V_2, V_3 etc., represent.

The arrangement followed is not particularly good. The time-worn method of dividing into chapters has been abandoned for a less effective one, and, further, the reader is jostled about from a description of types of engines and some of their parts, to theory, then to ignition and governors, followed by a section on gas-producers, which, though in the title relegated to Part III., are treated briefly in Part II., this section being obscurely located in between a description of the various kinds of gases which are utilized for power purposes and a section in which large gas engines are described.

On the first page of the "Contents" occurs a printer's error as in "Magnetic, make and break," the last word being spelled "brake."

In Part III., which, by the way, is better arranged than its predecessors, the absurdity of certain expressions which have come into rather common use is rightly pointed out. "Siemens Gas," "Dowson Gas," "Mond Gas," etc., are instanced, and these are compared with what would be perfectly analogous expressions applied to steam works. For instance, the steam generated in a Stirling boiler might, on the same principle, be called "Stirling Stam."

The illustrations throughout the book are good. clear and well chosen, while the subject matter is reliable. The question of arrangement is largely a matter of opinion after all. As a text book for a correspondence school from which students can obtain information on points which may not be quite clear it should prove to be very useful.

Logarithms for Beginners.—By C. N. Pickworth, Manchester. Published by D. Van Nostrand, New York City, and Emmott & Co., Manchester. 50 pages; 5 x 7 inches; cloth binding. Price, 30 cents net.

The author gives a detailed explanation of logarithms and their numerous applications, superior to that to be found generally in academic texts. As such the book should be welcomed. The fact that the newly published edition is the fourth speaks strongly in its favor.

The treatment is complete, with examples, exercises and answers, and with four-place tables of logs and antilogs. The chief feature of the fourth edition is a table of hyperbolic logarithms and an explanation of their use. One is again reminded that logs to base e (2.71828), called hyperbolic, or natural, logarithms, are not the Napierian logarithms, the assumption being erroneous that such logs were employed by Napier, and that, in reality, they were afterwards deduced from those invented by him.

Theory of the Flexure and Strength of Rectangular Flat Plates Applied to Reinforced Concrete Floor Slabs.—By Henry T. Eddy. Published by Rogers & Company, Minneapolis. Cloth; 6 x 9 inches; 104 pages; illustrated. Price, $5.00 net.

This treatise embodies the results of a mathematical analysis of the mushroom system of floor-slab design, invented and patented by Mr. C. A. P. Turner. Dr. Eddy, the author, has here given a rigid application of the mathematical theory of elasticity to the problem presented by multiple-way reinforcements.

In the introduction to the book Mr. Turner states that this discussion is intended as an advance chapter or two of a more comprehensive treatise on Concrete-Steel Construction, in which it is intended to treat somewhat fully concrete columns, beam and slab construction, wall panels, etc., as well as flat slabs, and to introduce the results of experimental work now under way to determine the value of Poisson's ratio for different combinations of steel and concrete. This treatise will then represent the joint efforts of a professional mathematician accustomed to treating these problems and a professional builder and designer of reinforced concrete with many years of practical experience behind him.

Rivers and Estuaries.—By W. Henry Hunter. Published by Longmans, Green & Company, 39 Paternoster Row, London. Canadian agents, Renouf Publishing Company, Montreal. Cloth; 6 x 9½ inches; 66 pages.

This little volume, which comprises an elementary study of "Rivers and Estuaries," is to a large extent based upon lectures on this subject, which were delivered by the author in the beginning of 1911 at the desire of the Council of the Institution of Civil Engineers, and under the Vernon-Harcourt bequest, to the students of the Institution in various parts of Great Britain; and upon further lectures on the subject of "Streams and Tides," delivered in the University of Manchester to the students in the Department of Engineering there.

The treatise contains a great deal of valuable information on the behavior of rivers under natural and artificial conditions, much of which information has been compiled from the author's personal experience. Some idea of the treatment of the subject may be obtained from the headings of the various chapters, viz.: Difficulties of the Subject, Physical Difficulties, the Pursuit of Information, Flow around Bends, Mouth of the River, River Improvement Works, Some European Examples, Some American Examples, the Mersey Estuarial Models.

The book is well written in clear and simple language, and forms a valuable addition to the literature of the subject.

Electric Interlocking.—(First edition.) Published by the General Railway Signal Company, Rochester, N.Y. 435 pages; 4 x 7 inches. Price, $3, postpaid.

"Electric Interlocking" is a handbook that will be of service in switch and signal practice, containing in well-printed, well-illustrated and durably-bound form a careful treatment of electrically-operated interlocking mechanisms and appliances. The handbook contains 284 illustrations, and many tables similar to those found in ordinary handbooks. Some of its illustrations and wiring diagrams have the current-carrying wires printed in red ink, making them readily distinguishable when referred to in the text. Sections are devoted to the installation and operating data of the various appliances, to wire and conduit work, installations in concrete, including general information covering methods of mixing and tables of volumes of materials required. Various sections also are devoted to standard signals, nomenclature of units, wires, etc.

The book will prove itself generally useful to railway men, not only for the newer instruction it contains, but for its concise form for reference and its carefully compiled index, covering in detail the entire work. The index is one of the distinctive features of the handbook.

The D'Este Steam Engineers' Manual.—Published by the Julian D'Este Company, Boston, Mass. 480+54 pages; 4½ x 7 inches. Price,

The manual is in two sections, Steam and Electrics. It contains a carefully selected mathematical introduction leading to the manipulation of logarithm and of steam tables, etc. The first part then covers mechanical details, such as the heating of feed water, shafting, size of pulleys, and the like, clearly and concisely, and, although we are of the opinion that the space devoted to elementary mechanics is somewhat unnecessary to the text, still it is largely a question of opinion, and is atoned for by the admirable treatment of mechanical energy and power transmission. The handbook also contains sections relating to internal combustion engines, mechanical refrigeration briefly.

Peculiar to this latest edition, which is the second, is an electrical appendix by Charles Penrose, E.E., which occupies some 360 pages, and is entirely distinct from the steam section. It is to be pointed out that the latter comprises a valuable addition of material not contained in the first issue of the manual, but that the electrical appendix outclasses the steam section to such a degree that the title of the book as given above hardly seems applicable.

The electrical section contains 240 illustrations of electrical equipment and diagrams, and no phase of electrical work that would be of interest to steam engineers has been overlooked. The section is, on the whole, well arranged as to prove itself of value for electrical engineers as well.

One feature which the book lacks is a suitable index. That relating to the steam section is buried in the midst of the text, illustrations are not indexed at all, and the index to the electrical appendix is scant. Overlooking these deficiencies, the manual is, as stated, greatly enhanced by the additional sections, and will prove itself almost indispensable to steam engineers. An attractive feature is in the comprehensive bibliography which supplements the steam section.

The Concrete House and its Construction.—By Maurice M. Sloan. Published by the Association of American Portland Cement Manufacturers, Philadelphia. 224 pages; 6 x 9 inches; illustrated; cloth binding. Price, $1.00 net.

This book endeavors to make clear the advantages of concrete in the construction of buildings. It compares in its preface the fire losses of American and European countries, and attributes the lack of fireproof construction to a mistaken idea of cost. It goes into detail with concrete construction as applied to houses, and should be particularly valuable to the architect.

Chapter I. deals with the advantage of concrete over other materials for house construction. Architectural design is dealt with in Chapter II., and in this chapter, as well as throughout the book generally, the illustrations are for the most part new and unique, certainly displaying a wide adaptability of cement in both the interior and exterior. Details, such as types of floor construction and reinforcement, roof and wall construction, are dealt with superficially in Chapter III., which is followed by general suggestions regarding construction operation, including the laying of reinforcement, the treatment of concrete surfaces, etc. The determination of strength and design of reinforced concrete in house construction suitably well covered, little of a technical nature being attempted, only sufficient to bring out general proportions of various members as called for by the loads to which they will be subjected.

Chapter VII. contains a number of tables for use in the design of reinforced concrete construction, giving resistance moments of floor beams or slabs, etc., for various diameters of reinforcing rods and spacings. Concrete block houses are lightly dealt with in the closing chapter, included in which are a number of illustrations showing the attractive character of concrete, even in its use as plain block, no ornamentation or pretentious manner being attempted.

The book is well printed and very handsomely illustrated, and the qualities which concrete construction possesses by way of durability, sanitation, fire resistance, etc., are carefully outlined.

Electricity for the Farm and Home.—By Frank Koester, A.M.A.I.E.E. Publishers, Sturgiss & Walton Company, New York. 279 pages; 5 x 7 inches; 35 illustrations; cloth. Price, $1.00 net.

Frank Koester's books generally lend themselves to careful reading by reason of the continued interest which is created as one progresses, and his latest book is no exception. He begins by pronouncing electricity as the greatest agent of agricultural problems, of vital importance to the city dweller as to the farmer. He devotes a chapter to the idea of central station service for farms and another to the generation of electric power by water steam, internal combustion, wind, storage battery, etc., and its distribution, turning then to the subject as viewed from the application of electric motors. A chapter on costs gives in concrete form valuable information for farmers, basing his data on a farm 100 acres in size. The manufacture of farm by-products, the preservation of farm products in general and their transportation are fully treated from the standpoint of electrical power utilization. The manipulation of farm machinery and divers applications is followed by a similar treatment respecting the household, such as electric heating, lighting, etc. An interesting chapter is that concerning electric power in irrigation and pumping system, and one even more interesting is the closing chapter devoted to the stimulation of vegetation by electricity, which, although it deals only with light experimental work and contains little practical information shows an application of electricity not generally known, but highly absorbing.

The book is well illustrated, and, although a great many of the cuts are reproduced from periodicals, the choice is very creditable.

Elementary Principles of Reinforced Concrete Construction.—By Ewart S. Andrews, B.Sc., Lecturer in Theory and Design of Structures at Goldsmith's College, New Cross, London. Publishers, Scott, Greenwood & Son. Cloth; 4½ x 7 inches; pages xi. + 195; 57 text figures. Price, $1.00 net.

Of the various elementary texts in reinforced concrete this is one of the best. The author has the faculty of being able to state the essentials of his subject in a clear and convincing manner to those whose knowledge of mathematics is limited. This is partly due to simplicity and directness of statement and partly to the excellent word-illustrations of the joint action of concrete and steel in a reinforced member. Numerous numerical examples are also given which will undoubtedly reassure the beginner in his application of the formulas to actual problems.

The introductory part of the book comprises a brief historical review of the use of reinforced concrete, and a lengthy statement of the notation employed—that of the Concrete Institute—after which the author proceeds with a discussion of the properties of concrete and steel, loads, working stresses, bending moments, and the distribution of loads on slabs. The latter is covered particularly well for a short text book. After this, direct compression and bending on reinforced concrete members receive full attention, adequate consideration being given to double reinforcement, an important feature of arch ribs, walls and chimneys. Chapter IX. contains an interesting and somewhat novel graphical treatment of reinforced concrete beams, based on the methods of Professor Mohr. While only of academic interest in the case of simple sections, it will be found of use in handling irregular or unusual ones. The closing chapters concern shearing stresses, deflections, columns, leading systems of construction and twenty typical exrcises. A few common mathematical tables are also included.

Apart from the disadvantage of a notation differing considerably from that now regarded as practically standard on this side of the ocean and the characteristic British terminology, the book is thoroughly acceptable. Some slight errors exist, as in the use of the word "strain" for "stress" on page 22, the numbering of two figures the same (22), and a few misspelt words. On the whole, the author's work ought to prove very useful and helpful to the young designer in reinforced concrete.

Steel Rails.—By William H. Sellen. Published by D. Van Nostrand Company and Constable & Company. 523 pages; 7¼ x 10¼; 361 illustrations and 33 folding plates. Pıice, $12.50 net.

Reviewed by T. R. Loudon.

Since the introduction of the use of the steel rail, no other steel commodity has received so much attention, both by the railway companies and the steel manufacturers. It is not so long ago that the worst possible confusion existed as to the proper section of rail for a given traffic condition. Of late years, however, more or less uniformity has been reached, but this state was not brought about without a tremendous amount of discussion. At the present time, so heavy are the traffic conditions that the question of proper rail specifications is again giving rise to another important series of discussions. All this discussion, past and present, is so widely distributed throughout the technical literature that it is an almost insurmountable task to begin to follow any given phase from the beginning up to the present time. To those familiar with the manufacture of the steel rail, this is only too well known. To pick and choose and intelligently synopsize the above referred to discussions is a work that is worthy of note. This is a task that has been undertaken and carried out in an extremely creditable manner by the author of this book. From the historical standpoint alone the information compiled in this book is invaluable.

The first chapter is written with the evident purpose of tracing the evolution of the present-day rail section. The purely historical data is interesting. Apart from this, the matter is so put together that the reader sees very clearly the reasoning that has led to the use of the modern rail section. In summing up this chapter, the author points out very properly that the ability of a rail to resist the loads to which it is subjected is dependent as much upon the character of the metal as upon the section. The point is very properly made, coming, as it does, in the first chapter. These last two paragraphs could stand being more prominently set up.

Chapter II. deals with the pressure of the wheel on the rail. In this section of the book the author goes into the additions that must be made to the static wheel loads in order to arrive at the actual load under running condidions. The effects of the various factors, such as the lack of balance in the reciprocating parts of the locomotive, of irregularities in the track, rocking of engine, flat spots on wheels, are considered in detail. The data given is exceedingly extensive and well presented. While it is always possible to arrive at a definite figure for the unbalanced forces due to reciprocating parts of a locomotive, it is not very easy to arrive at a definite method of analysis of the other known causes of excess pressure on a rail. The author quotes the various theories and tests in a very interesting manner. The information given on electric cars and upon ordinary cars is extremely up to date.

Chapter III. is devoted to supports of the rail. The first part of this chapter is taken up with the description of the various forms of ties used. The descriptions are brief, and the reasons for and against the use of the various forms of ties are to the point. A large portion of this section is devoted to the discussion of the ordinary wooden tie. Some interesting data is given on forestry as applicable to the production of railroad ties. A comparison of the half-round ties, which are used a great deal in Europe, with the American form of tie is made, and it is quite clearly shown that not only from the standpoint of desirability for track support, but also from the standpoint of economical production, the half-round should be used. Descriptions of various forms of tie-plate and fastenings are then given. The last part of the chapter is devoted to a discussion of the strength of ties under various treatments.

"Stresses in the Rail" is the heading for Chapter IV. The first portion of this chapter is more given over to discussing wear on tires, which is well put together and interesting, but is not very well worked into the subject of the chapter. A statement is made farther on relative to the heating of a rail due to slipping of drivers. It is stated that the running surface is hardened by this overheating and cooling, due to the surrounding metal conducting the heat away quickly. Quite true, the surface of a rail is heated by slipping of drivers. As the author points out, the shower of sparks when slipping takes place attests to this, but even though a small portion of the rail were heated, there is no doubt that the surrounding metal cannot conduct the heat away quickly enough to produce hardening. Certainly the effect cannot be as the author states: "Similar to quenching steel from high temperature in water, etc." In cold or moist weather some effect might be noticed, but this would be doubtful. In the discussion of bending and shearing stresses and the efficiency of rail joints a great deal of very accurate information is quoted. For use as splice-bars, the author favors oil-treated steel, presumably about fifty points of carbon. The statement is made that "oil-treated steel is as much in advance of high-carbon steel as is the latter over soft steel." Presumably this refers to the higher carbon steels being oil-treated. The point is not clear. The context, however, quotes a fifty-point carbon steel used by Cambria Steel Company. The information quoted on Rail Splices is well worth careful consideration.

In Chapter V. the strength of the rail is taken up. A great deal of information on repeated stresses is given and applied to the case of a rail under service. It might have been as well to have gone more carefully into the discussion of the internal structure of steel than is done at the beginning of the chapter. The subject is one requiring careful consideration or it had better be left alone. The discussion of what constitutes a crystal and what is referred to by a crystalline grain in steel is one which is very confusing unless the reader is familiar with the study of alloys, and the iron carbon series in particular. The chapter also deals with the effect of temperature on the strength of a finished rail and on the methods of testing.

The Influence of the Detail of Manufacture is discussed in Chapter VI. The first portion of the chapter is taken up with a description of the methods of manufacture of steel and the influence of certain elements on steel. There are certain inaccuracies in the descriptions that are inevitable in a synopsis. For instance, in the description of the Bessemer process it is stated that, "The combustion of this carbon (in the molten pig iron) increases the heat of the metal, and the flame . . . is at first red, but rapidly becomes brighter, etc." No mention is made of the burning of the silicon, which, in our present Acid Process, is the most important element in maintaining the temperature of the process. The first "flame" while the silicon is burning as a matter of fact is not a true flame. This is doubtless what the author had in mind, but the description is loose. In discussing the treatment of the ingot the author has gone to considerable pains in collecting the most up-to-date information. The section on mechanical work is also very well put together.

The last chapter is made up of various rail specifications, and on account of the wide range given is valuable.

As stated before, there are a number of plates. The drawings show up well on the dead white paper, the dimensions being very clear.

The book is a credit to the author, and is evidently the result of an enormous amount of labor in gathering information.

PUBLICATIONS RECEIVED.

Canadian Railway Club.—Official proceedings of the club, Montreal. James Powell, secretary.

Cloth Pinions.—Illustrated bulletins. Issued by the Canadian General Electric Company, Limited, Toronto, Ont.

Air Compressors.—Illustrated bulletin. Issued by the Canadian General Electric Company, Limited, Toronto, Ont.

Map of Gowganda Mining Division.—Issued by the Geological Survey of Canada, and covering twenty-eight townships in that district.

Forest Products of Canada.—Statistics as compiled by R. G. Lewis, B.Sc.F., on pulpwood. Issued by the Department of the Interior, Canada.

Electricity in Excavation and Construction Work.—Illustrated bulletin, 28 pages. Issued by the Canadian General Electric Company, Limited, Toronto, Ont.

Ontario Agricultural College.—Thirty-eighth annual report. Issued by the Ontario Department of Agriculture, Toronto.

Inspectors of Factories.—Twenty-fifth annual report of inspectors. Issued by the Provincial Government, Toronto, Ont.

Report of City Engineer, Hamilton.—Annual report for year enaing December 31st, 1912, of Mr. A. F. Macallum, city engineer.

Queen Victoria Niagara Falls Park.—Twenty-seventh annual report of the Commissioners. Issued by the Provincial Government, Toronto, Ont.

Prisons and Reformatories.—Forty-fifth annual report of the Inspector of Prisons and Public Charities. Issued by the Provincial Government, Toronto, Ont.

Rain Statistics, Compiled by the Department of Trade and Commerce for the Year ended March 31st, 1912.—Part V. of the annual report of the Department.

The Analysis of Black Powder and Dynamite.—Technical bulletin by Walter O. Snelling and C. G. Storm. Issued by the United States Bureau of Mines, Department of Interior.

The Currents in the Entrance to the St. Lawrence, from investigations of the tidal and current survey in the seasons of 1895, 1911, and 1912. Published by the Department of the Naval Service at Ottawa.

Revenues and Expenses of Steam Roads in the United States for the Month of April, 1913.—Bulletin No. 53, prepared by the Division of Statistics, and issued by the Interstate Commerce Commission.

The Determination of Internal Temperature Range in Concrete Arches.—By C. S. Nichols, B.C.E., and C. B. McCullough, B.S. Bulletin No. 30 of Iowa State College, Engineering Experiment Station.

Trade and Navigation Statements.—Unrevised monthly statements of imports entered for consumption and exports of the Dominion of Canada for the month of April, 1913. Issued by the Minister of Customs, Ottawa.

The Inspector of Prisons and Public Charities' Report.—Forty-fifth annual report on hospital for feeble-minded and epileptics for the year ending October 31st, 1912. Issued by the Provincial Government, Toronto, Ont.

The Theory of Loads on Pipes in Ditches, including Tests of Cement and Clay Drain Tile and Sewer Pipe.—By A. Marston and A. O. Anderson. Bulletin No. 31, Engineering Experiment Station of Iowa State College.

Topographical Surveys Branch Report.—Contains the annual report of the topographical survey branch for the year 1911-1912. 260 pages. Illustrated, and includes 17 sketch and topographical maps. Issued by the Department of the Interior, Ottawa.

Report of the Railway, Telegraph and Telephone Department of the Province of Saskatchewan for the year ending February 29th, 1912.—A pamphlet containing over sixty pages of reports from officials in charge of the several branches of the department.

The South African Institute of Electrical Engineers.—Contains transactions of the Institute and copies of papers read by members, among them an interesting paper on "Water-power Plants," by W. Eldson-Dew. Issued by the Institute. The Corner House, P.O. Box 4563, Johannesburg.

Technical Paper No. 44, United States Bureau of Mines.—A paper by H. H. Clark on Safety Electric Switches for Mines, based on study and investigation of causes of mine accidents, and dealing with the design of switches to prevent gas ignition upon operation under load.

Transactions of the Institute of Marine Engineers.—Contains copy of papers on "Thermodynamics and Refrigeration." By G. James Wells, and lecture on "Refrigeration," by Robert Balfour. Issued by the Institute, 58 Romford Road, Stratford, Eng.

Engineering Experiment Station.—Bulletin No. 31.—Illustrated. Contains papers on "The Theory of Loads on Pipes in Ditches," and "Tests of Cement and Clay Drain Tile and Sewer Pipe," by A. Marston and A. O. Andrews. Issued by the Iowa State College of Agriculture and Mechanic Arts, Anus, Iowa.

Engineering Experiment Station.—Bulletin No. 30.—Illustrated with maps inset. Contain papers on "The Determination of Internal Temperature Range in Concrete Arch Bridges," by C. S. Nichols and C. B. McCullough. Issued by the Iowa State College of Agriculture and Mechanic Arts, Anus, Iowa.

Engineering Experiment Station.—Bulletin No. 31.—Illustrated. Contains papers on "The Theory of Loads on Pipes in Ditches" and "Tests of Cement and Clay Drain Tile and Sewer Pipe." By A. Marston and A. O. Anderson. Issued by the Iowa State College of Agriculture and Mechanic Arts, Anus, Iowa.

Progress of Stream Measurements.—Report by F. H. Peters, C.E., for the Department of the Interior. A 310-page book, with 62 plates and numerous maps and tables covering the work accomplished by the Department in the measurement of stream flow during the year 1911, by P. M. Sauder, C.E., chief hydrographer.

Ohio State Board of Health.—Monthly bulletin containing articles relating to public health, the significance of occupational diseases, and a brief outline of the two new divisions of the State Board of Health recently created by legislative action. Prepared by E. F. Campbell, Ph.D., M.D., and issued by the Board, Columbus, Ohio.

United States Bureau of Mines.—Report No. 37.—Containing a paper by Irving C. Allen on "Heavy Oil as Fuel for Internal Combustion Engines." A 36-page pamphlet presenting the result of an extended research for some means of more effectivly burning heavy asphaltum oils as fuel for steam-raising and for engines of internal combustion type.

Report of the Minister of Public Works.—Report on the Ottawa River storage and notes on a visit to the Panama Canal; also on geodetic levelling between Stephens, Minn., and Winnipeg Beach, Man., and between Trenton, Lake Ontario, Orillia and Lake Couchiching, Ont. Fully illustrated. Issued by the Department of Public Works, Ottawa.

United States Bureau of Mines.—Bulletin 62.—Dealing with the Mine Rescue and First Aid Conference, held last September in Pittsburg, Pa., containing addresses and discussions and reports of sub-committees. The bulletin also contains resolutions adopted at the Conference and the proposed constitution for a permanent national mine rescue and first aid association.

Progress of Stream Measurements.—Report of F. H. Peters, C.E., on stream measurements for the calendar year of 1911. The report gives a brief outline of the methods of obtaining and compiling data, and gives in a tabulated form almost all of the records of stream-flow during 1911.? Illustrated, and contains map showing the gauging stations in Alberta and Saskatchewan. Issued by the Department of the Interior, Ottawa.

Super-heated Steam Engines.—Economical and reliable generation of power by over-type super-heated steam engines from a paper read by W. J. Marshall, A. M. I. Mech. E., before the British Association at Portsmouth. The descriptions and data relative to the construction and operation of the Garrett engine, manufactured by Messrs. Richard Garrett & Sons, Limited, Leiston, Suffolk, are most interesting and cover twelve pages of 10 x 12 concisely printed type.

The Journal of the Royal Astronomical Society of Canada, May-June number, containing an interesting article by Prof. A. C. Chant on the extraordinary meteoric display observed on the evening of February 9th, 1913. The article deals very scientifically with the occurrence, and contains reports of observations from many localities throughout Canada. Another article of interest is by W. F. King, chief astronomer, Ottawa, bearing upon the new reflecting telescope for the Dominion Observatory.

Some Facts about Treating Railway Ties.—Parts I. and II. of which were published in 1912, and were devoted to descriptions to various processes of wood preservation and improved methods of treating railway ties. Parts III., IV., V. and VI, dealing with the mechanical life of ties, a comparison of zinc chloride with creosote for preserving, a history of wood preservation in Europe and America, and a list of treating plants, together with their location, capacity, processes, etc., have just been published. The treatise is bound in three pamphlets, aggregating 200 pages, 6 by 9 inches, and costing $1.50 per set.

CATALOGUES RECEIVED.

Mikado Locomotives.—Illustrated bulletin issued by the American Locomotive Co., New York, U.S.A.

Architecture.—A catalogue of books relating to architecture. Issued by B. T. Batsford, 94 High Holborn, London.

Channon's Review.—Illustrated catalogue of the company's general machinery and supplies. Issued by the H. Channon Co., Chicago, Ill.

Armstrong Drop Forged Steel Wrenches.—A 32-page illustrated booklet covering wide range of wrenches with sizes and prices, of Armstrong Brothers Tool Co., Chicago.

Direct Current Apparatus.—Electrical catechism concerning the conventional questions asked by prospective buyers. Illustrated. Issued by the Fairbanks, Morse and Co., Chicago, Ill.

Alternate Current Apparatus.—Illustrated bulletin containing general information in regard to alternate current apparatus. Issued by the Fairbanks, Morse and Co., Chicago, Ill.

Clyde Iron Works Co.—An original style of catalogue concerning their output of hoisting machinery may be obtained on application to the Clyde Iron Works, Duluth, Minn., U.S.A.

Concrete Machinery.—170 page illustrated catalogue of the different types of concrete machinery manufactured by the company. Issued by the London Concrete Machinery Co., Ltd., London, Ont.

Electric Arc Welding Apparatus.—28-page catalogue, well illustrated and containing a complete description of the new multiple unit arc welding outfit. Issued by the C. and C. Electric and Manufacturing Co., Garwood, N.J.

Comparison Between Low Pressure Water Turbines and Centrifugal Pumps and the inferences applied to the construction of irrigation and drainage installations. Illustrated. Issued by the Escher Wyss and Co., Zurich.

The Labor Saver.—Illustrated catalogue devoted to the automatic handling of materals in construction, published in the interest of efficiency and economy in production. Issued by the Stephens-Adamson Manufacturing Co., Aurora, Ill.

What Users Say About the United States Graphite Company's Mexican boiler graphite. A handsomely-bound, printed and well-edited 64-page booklet dealing with scale in boilers and its prevention by the use of the company's product.

Modern Blue-Printing.—By P. M. Morgan, an 8-page pamphlet dealing with the Pease "Peerless" continuous blue-printing equipment, and abstracted from an article appearing in May 29th issue of *The Canadian Engineer*, published by E. R. Watts, Canada, Ltd., Canadian Agent for the C. F. Pease Co., of Chicago.

Steel Armoured Concrete Pipes for Pressure, Drainage and Water Conduits.—A 20-page catalogue descriptive of Siegwart pipes of reinforced concrete, together with tables of measurement, results of tests and diagramatic illustrations of stresses. The International Siegwart Beam Co., Lucerne, Switzerland, Canadian Agency, F. T. Kaelin, 611 Power Building, Montreal.

Cheap Steam and Machine-Firing.—A 28-page illustrated catalogue containing concise description of the construction and operation of the Gold Medal machine stoker, reports of active tests, and machines in situ on leading types of boilers, the drawings of which should be especially interesting to steam users. Copies may be obtained gratis from G. H. Tod, Manning Chambers, Toronto.

The Explosive Concrete Pile.—A set of bulletins issued by the International Siegwart Beam Company concerning concrete piles "exploded" at the base to afford efficient expansion desirable for foundations on bad ground. Records of trials are contained therein and the bulletins are well illustrated, and printed in English, French and German. Canadian agent, F. T. Kaelin, 611 Power Building, Montreal, Que.

L. S. Starrett and Co.—Illustrated catalogue, No. 20, 320 pages, contains interesting descriptions, illustrations and prices of all kinds of tools for machinists, carpenters, draftsmen, engineers, chauffeurs and other mechanics. In addition there are many pages of data and tables such as metric conversion tables, decimal equivalents, weight computing tables, tapers and angles, wire gauge tables, etc. The arrangement of the catalogue has been somewhat changed from that of No. 19, which makes it easier for reference. Issued by L. S. Starrett and Co., Athol, Mass.

The "Stoney" Sluice and its Application to Water Storage and Control.—144-page catalogue, fourth edition, descriptive of "Stoney" control sluices of which Ransome and Rapier, Ltd., London and Ipswich, England, are the manufacturers. Contains many interesting illustrations of installations and general information relative to water control, ice and flood conditions, general properties of weirs, etc. The work is supplemented by numerous tables and diagrams and the items are carefully indexed making the publication one of value for waterworks' engineers. Issued from the London office of Ransome and Rapier, Ltd., 32 Victoria Street, S.W., London, England.

COAST TO COAST.

Toronto, Ont.—The new custom house planned with other new Dominion Government buildings in this city, will cost $2,000,000 when completed. Yonge and Front Streets will be widened to provide an approach to the new buildings. The new Union passenger station will also cost in the neighbourhood of $2,000,000.

Winnipeg, Man.—Applications have been invited in London, for subscriptions for a city of Winnipeg loan of $3,450,000 at 4½ per cent., the price being 97. The loan, which is redeemable at par in 1963, will be utilized for the extension of the civic water supply and electrical and other public works. Winnipeg's existing liabilities, exclusive of the present issue, amounts to nearly $35,000,000.

Halifax, N.S.—The Halifax Automobile Association has inaugurated a good roads movement along unique lines. On the 23rd inst., all the auto-owners in the city will start out in their cars with over-all laborers in each, and a plan to thoroughly repair a bad stretch of some twenty miles of road outside the city. Finding that previous financial efforts have failed, the owners now intend to devote their own muscle to improving the highways.

Victoria, B.C.—Plans for the harbor work for this season at Victoria have now been completed by the engineering branch of the Public Works Department at Ottawa, and as soon as the specifications are printed tenders will be called for. The work calls for the building of two peirs, one of a thousand feet and the other eight hundred and seventy feet in length. They will be built of concrete and crib work, and will provide three berths for the largest liners. The estimated cost of the work is around two million dollars, and it is said that Victoria will be made a real national port, capable of handling the largest steamers and of taking care of the development which is looked for with the opening of the Panama Canal.

Ottawa, Ont.—Early developments are expected in connection with the Chats Falls water power which the Ontario Hydro-Electric Commission is endeavoring to secure Mayor Ellis and members of the commission are at Chats Falls looking over the location, and it is understood that immediate action will be taken to hurry matters along. The commission has already served formal notice of expropriation on the private owners of the water powers. But a more important movement is that which it is understood is contemplated by the Dominion Government, the making of complete investigations with a view to cancellation of the transfer by the Laurier government of the most important part of the water power. Ottawa is vitally interested in the matter, as if the Hydro-Electric Commission secures the water powers at Chats Falls, the current for the municipal electric department will come from the plant which would be erected there to serve eastern Ontario.

Victoria, B.C.—The proposal of Sir Richard McBride that the governments of Canada and the United States shall unite in constructing a trunk line of railway that will connect the Alaskan and Canadian lines, is being received with favor wherever it is mentioned. In a private letter from Hon. J. F. A. Strong, Governor of Alaska, he expresses his hearty sympathy with the proposal and his willingness to do whatever he can to promote the mutual welfare of Canada and Alaska. Speaking generally, the proposed railway would be a main artery carrying the life blood of progress to an area of more than three-quarters of a million square miles of territory rich in natural resources of various kinds. Northern British Columbia and the Yukon Territory contain, by careful estimate, sufficient arable land to support a million people by agriculture. The Alaskan Agricultural Bureau, after careful investigation, has reported that "the total tillable and pasture land of Alaska is estimated at 64,000,000 acres," and adds, "all the crops that can be raised in Sweden, Finland and the northern provinces of Russia—potatoes, root crops, barley, oats, carrots, beets, turnips and celery—can be raised there." The bureau also says that "there is more agricultural land in the Lanaux Valley than is now under cultivation in the corresponding regions of Norway, Sweden, Finland and the four northern provinces of Russia." The mineral wealth of the whole region is enormous. This imperial area, which is almost equally divided between Canada and the United States, is at present absolutely cut off from land communication with existing railway systems, and can only be reached by a sea voyage of several days' duration, which militates very greatly against its development. There are already between five hundred and six hundred miles of railway, either constructed or in the course of construction, in this great and only meagrely exploited region.

Montreal, Que.—The financial stringency will have little effect, it is expected, on the city's programme of public works for the summer. No attempt has yet been made to raise the new $13,000,000 permanent loan, for which authority was secured some time ago. The city is not now in actual need of the money, and to place a new loan on the market at a time when it is not likely to meet with success, would, it is felt, only damage the city's credit unnecessarily. "We shall have no difficulty in raising any money we may need on temporary loans," J. Pelletier, City Comptroller and Auditor, said recently, "and then when the market improves we can float a permanent loan and pay off the temporary ones. We have not enough money actually in hand to meet the year's programme, because we naturally borrow money as we need it to save the interest. Besides, it is impossible to say beforehand how much of the work will be done. A few week's rain, for instance, might interfere with the programme very materially. But there is no danger of work being held up for lack of funds, so far as Montreal is concerned. We can always secure all we need on temporary loans." The city, however generously inclined, it was stated by a city official, has no authority to give financial assistance to outside municipalities, where work has had to cease for lack of money.

Montreal, Que.—The duties of a road engineer in Montreal are no sinecure—according to John R. Barlow, the city road surveyor. Montreal, according to Mr. Barlow, is built on a strange geological formation and is subjected to extraordinary climatic conditions which make the construction of roads very difficult. "Running right under the city," he said, "are great belts of blue clay and quicksand. During prolonged rains, these belts expand forcing the surrounding earth outwards. When the hot weather comes, they contract and there is a subsidence of the surrounding earth. If this occurs under a roadway, it does not take an expert to see what will happen. Every street in Montreal has to be built according to its own peculiar conditions. Permanent paving is to my mind the only solution of the street problem in Montreal. There should be a good foundation of concrete to prevent the roadway from sinking. Just to illustrate our difficulties. We sometimes find in repairing a permanent pavement, that the earth underneath the concrete bed has been completely washed away, leaving a concrete bridge from side to side of the street, and this has to support the full weight of the traffic. The macadamized road cannot last long in Montreal. You may build a road as well as you like, but if you have a keen winter the frost will sink into it as much as six feet and when that frost comes out in spring it will break up the road. There has been some criticism lately with regard to the stone we use on our macadamized roads. We are charged with wasting money on limestone. As a matter of fact we have never used limestone, except perhaps on a back street or two near a quarry. The greater part of the stone we use is seissel, which has a closer grain even than granite and has been pronounced by experts to be one of the best macadamizing stones on the continent.

Quebec, Que.—The necessity of completing the work of dredging the north channel of the St. Lawrence below Quebec as soon as possible is receiving the attention of the Marine Department. For this purpose in a very short time an additional dredge, one of the largest in the world, which will be capable of discharging into barges or its own hoppers will be put into commission. The work will thus be completed in a shorter time. Representations for the early completion of the work have been made by the Quebec board of trade on the ground that as new and larger vessels are being continually added to the St. Lawrence route the north channel should be finished. In order to obtain a 35-foot channel at extreme low tide with a width of 1,000 feet by way of the north channel below Quebec from St. Jean Island of Orleans to Goose Cape, 18,000,000 cubic yards of material will have to be removed. Of this amount 3,000,000 cubic yards have been dredged up to date. With the new plant it is expected that all the work will be concluded in four more years. The completion of the dredging of the north channel will greatly enhance the value of the St. Lawrence route for it is much superior to the south channel. With the proposed aids to navigation the north channel will be easier to navigate than the south. It will have a very short length of 35 feet and will not require buoys and lightships as the present long and tortuous channel. It will also be easy to navigate in the winter months.

Ottawa, Ont.—Fairly satisfactory is the way Mr. Joseph Race, city bacteriologist, sums up the results of the tests made of the city water during June. During the month 904 samples were examined, this number being made up as follows: Water city supply, 187; wells, general, 72; well, Ottawa Dairy Co., 19; water from carts, 14; water, miscellaneous, 15; milk, 462; cream, 6; hypochlarits, 120; sputum, 5; diptheric swabs, 4; total, 904. The bacterial contents of the ward samples of water has been above the average during the past month but it is now again normal. No adequate reason can be found for this. The city samples, on the whole, have been fairly satisfactory. The only change made during the month as to hypochlorite was to increase the amount added at Queen Street from 100 to 150 lbs. per day. The private wells examined during the month have generally shown a marked increase in quality but a number of those previously reported as contaminated still contain organisms indicative of past pollution. In connection with the bacteriological examination of well water or any description of water, Mr. Race points out that the tests employed in the direction of the detection of organisms of farcal or escremental origin and that the presence of such organisms does not necessarily imply that the sample containing them is injurious to health. If the organisms are derived from a healthy person or animal no ill effects would be observed, but if the sewage is that of a person suffering from typhoid or dysentery the water would be infected and would produce disease in a susceptible individual. It is this difference between an infected water and a contaminated or polluted water that must be borne in mind. A polluted supply is dangerous because it may become infected at any time by a person suffering from typhoid or by a carrier.

PERSONAL.

Mr. BION J. ARNOLD, of Chicago, assisted by Mr. G. W. MOYES, of this city, has commenced the investigation of street railway traffic conditions in Toronto.

E. F. BRADLEY has been appointed manager of the Toronto office of the International Engineering Works, Limited.

K. S. MACLACHLAN, B.A.Sc., has recently been appointed superintendent of the Metals Chemical Company, of Welland, Ont., ore smelters and refiners.

Mr. WILLIS CHIPMAN, of the firm of Chipman & Power, Toronto, has been called into consultation by the city of Edmonton, Alta., in regard to the site of the proposed filtration plant.

Mr. J. G. S. HUDSON, consulting mining engineer, Department of Mines, Ottawa, is at present in Nanaimo, B.C., on an investigation trip concerning explosives. It is understood that one of the measures to come before the Federal House next session is a new Explosives Act.

ARTHUR H. BLANCHARD, M. Can. Soc. C.E., Professor of Highway Engineering in Columbia University, has been retained as Consulting Highway Engineer by the Department of Efficiency and Economy of the State of New York.

PREVOST HUBBARD, in charge of the Division of Roads and Pavements of the Institute of Industrial Research, Washington, and lecturer in Engineering Chemistry in Columbia University, has been retained as Consulting Highway Chemist by the Departmnt of Efficiency and Economy of the State of New York.

Mr. W. ARMSTRONG, Canadian manager of the Canadian P. J. Mitchell Company, Limited, has resigned his position in order to become managing-director of the newly-formed Armstrong-Kerr Company, of Vancouver, contracting engineers. Mr. Armsstrong is now en route to Vancouver, having returned last week from England, where he secured several desirable agencies for his new firm.

Mr. D. EWART I.S.O., chief architect, Department of Public Works, Ottawa, is on a tour of official inspection across the Dominion. Mr. Ewart will stop at all places where important public works are in progress. The Department at present has several large undertakings under way in the west, and more of them planned, such as large dry-docks on the Pacific coast and storage elevators at various western points.

Mr. RICHARD V. LOOK, of Louisville, Ky., formerly vice-president of the American Creosoting Company, has been elected president of the Canada Creosoting Company, Limited, and will move to Toronto this week to assume his duties. Mr. Look's office will be in the company's head office in the Canadian Pacific Railway building, Toronto. As president of the company he succeeds Mr. Hurt, the president of the American Creosoting Company, who acted temporarily as president of the Canada Creosoting Company, Limited, during its organization.

Mr. A. E. GRANT has been appointed managing-director of the Canadian British Insulated Company, Limited. For the last twelve or thirteen years Mr. Grant has been with the British Insulated and Helsby Cables, Limited, England, which company is the chief stockholder in the Canadian firm. Since 1906 he has been manager and chief engineer of the Cardiff office, which controls the firm's business in the south-western counties of England and in South Wales. He is a brother of Mr. Lawford Grant, president of the British Insulated Company, Limited, who recently resigned his former position as managing-director in order to accept an important post with the Eugene Phillips Electrical Works, Limited.

COMING MEETINGS.

THE INTERNATIONAL GEOLOGICAL CONGRESS.—The Twelfth Annual Meeting to be held in Canada during July and August. Opening day of the Toronto Session, Thursday, August 7th. Secretary, W. S. Lecky, Victoria Memoriam Museum, Ottawa.

THE ROYAL ARCHITECTURAL INSTITUTE OF CANADA.—Sixth General Annual Assembly will be held at Calgary, Alberta, September 15th and 16th. President, J. H. G. Russell, Winnipeg, Man.; Hon. Secretary, Alcide Chaussé, 5 Beaver Hall Square, Montreal, Que.

CANADIAN PUBLIC HEALTH ASSOCIATION.—Annual Meeting in Regina, September 16th, 17th and 18th. General Secretary, Major Drum, Ottawa; Local Secretary, Dr. Murray, Regina.

AMERICAN ROAD CONGRESS.—Annual Session will be held in Detroit, Michigan, from September 29th to October 4th. Secretary, J. E. Pennybacker, Colorado Building, Washington, D.C.

AMERICAN SOCIETY OF MUNICIPAL IMPROVEMENTS.—Twentieth Annual Meeting to be held in Wilmington, Del., October 7th to 10th. Secretary, A. Prescott Folwell, 15 Union Square, New York.

UNITED STATES GOOD ROADS ASSOCIATION.—Convention will be held at St. Louis, Mo., November 10th to 15th. Secretary, J. A. Rountree, L021 Brown-Marx Building, Birmingham, Ala.

AMERICAN ROAD BUILDERS' ASSOCIATION.—Tenth Annual Convention to be held in First Regiment Armory Building, Philadelphia, Pa., December 9th to 12th. Secretary, E. L. Powers, 150 Nassau Street, New York, N.Y.

THE INTERNATIONAL ENGINEERING CONGRESS.—Convention will be held in San Francisco in connection with the International Exposition, 1915.

THE WESTERN CANADA IRRIGATION ASSOCIATION.—Meeting to be held at Lethbridge, Alberta, on August 5th and 6th, 1913. Secretary, Norman S. Rankin, Calgary, Alta.

AMERICAN CONCRETE INSTITUTE.—First Annual Convention to be held in Chicago, February 16th to 20th, 1914. Secretary, E. E. Krauss, Harrison Building, Philadelphia, Pa.

READERS SHOULD NOTE THE REMOVAL OF THE LIST OF CANADIAN TECHNICAL AND MUNICIPAL SOCIETIES FROM THIS PAGE TO PAGE 94, IN THE REFERENCE SECTION OF **THE CANADIAN ENGINEER.** BY THIS CHANGE, ALMOST AN ENTIRE PAGE OF READING MATTER IS ADDED WEEKLY.